

SCIENTIFIC AMERICAN

A Weekly Review of Progress in
INDUSTRY • SCIENCE • INVENTION • MECHANICS



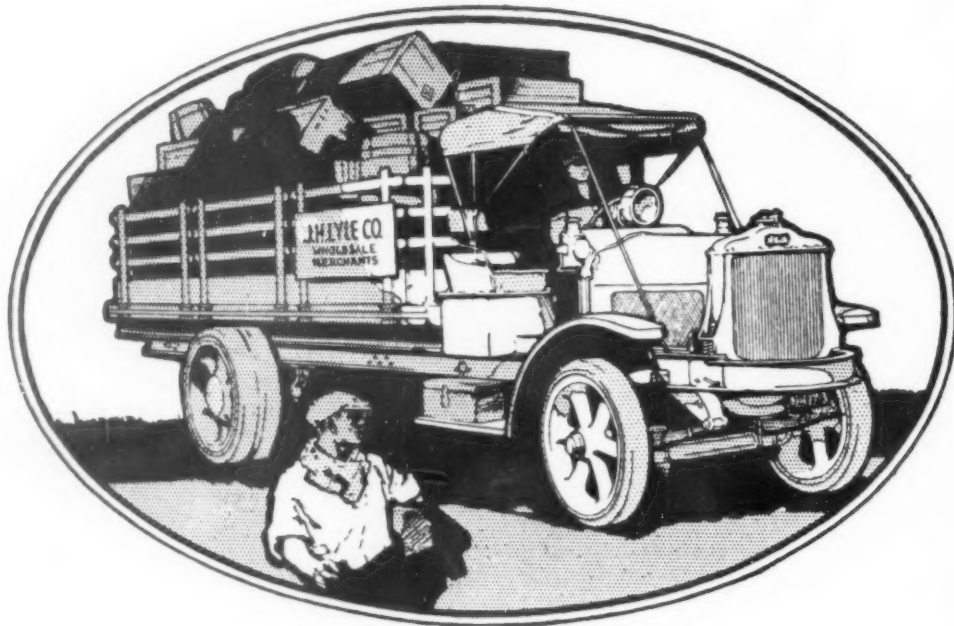
PROGRESSIVE ASSEMBLY IN THE AUTOMOBILE FACTORY

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Rochester, New York





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"Ask the Man Who Drove One in France"

PACKARD MOTOR CAR COMPANY, Detroit

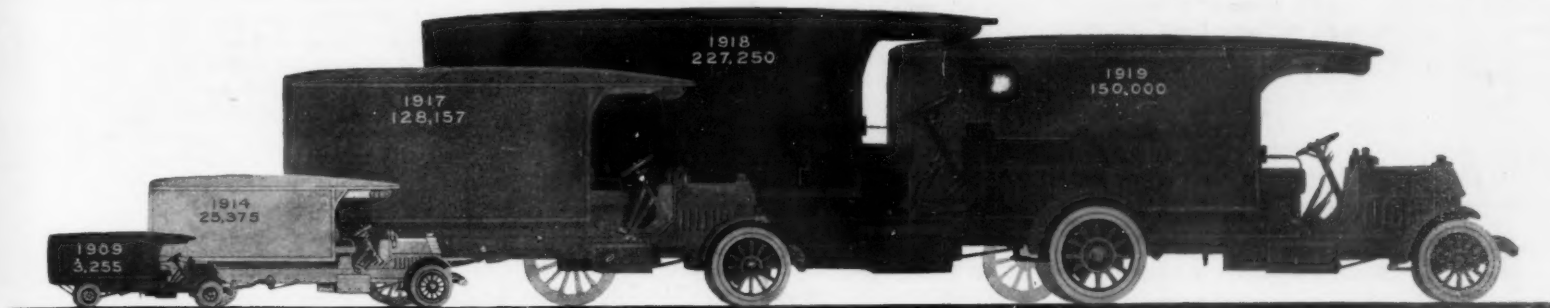
SEVENTY-SIXTH YEAR

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The production of motor trucks from 1909 to 1919, shown by composite trucks whose bulks are proportional to the figures that they represent

The Growth of the Automobile

Do you recall when the appearance of a "horseless carriage" on the streets was the signal for all the small boys in the neighborhood to trail along in the wake of the monster with ribald cries of "get a horse"? Do you recall when the word "automobile" was making its reluctant debut in the English language, and the substitute "auto-go-but-don't" was fraught with tragic truth? If you do, you will feel no disposition to quarrel with the theme of our lower drawing, which presents a group of automobiles, drawn so that their bulks are proportional to the total output of cars for the years which they represent. It will appear at first glance that the tiny car that stands for the small beginnings of the industry in 1899 does not look like the automobiles of those primitive days; the fact is, we have made all these cars in the same mold to afford a more definite size comparison.

It will be noted that from the 3,700 automobiles of 1899 to the 127,731 of 1909 the increase from each five-year period to the next was substantially uniform, being each time just about 600 per cent. But after 1909 the automobile industry was no longer an infant one, and while the numerical increase became even heavier after that date, the ratio of growth had to fall off, or the entire face of the land would have been covered by a solid blanket of automobiles. Even so, the 400-per-cent jump in the five years from 1909 to 1914, and the 300-per-cent increase in the following three years, are large enough to make a striking appeal when represented graphically as in our drawing.

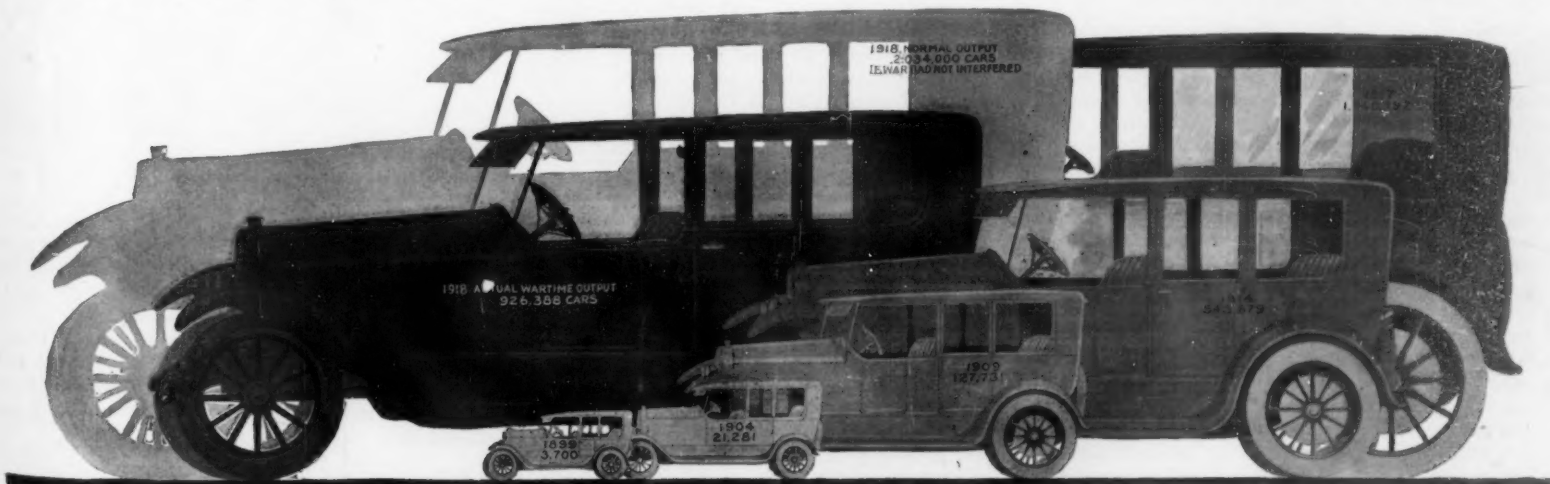
It is of course a good deal of a problem to say just

what the war did to the automobile industry. We know well enough that in 1917 there were manufactured in round numbers a million and three quarters cars; and that in 1918, while the war was waging, this figure fell to a little more than nine hundred thousand. But if we are to estimate with any attempted accuracy the effect of the war, we must compare the latter figure, not with the actual production for the previous year, but with the production that would have followed normal conditions in 1918—and this no man knows. From 1914 to 1915 the percentage of increase was 50; from 1915 to 1916 it was 80; from 1916 to 1917 it was 20; in the face of these fluctuations, what would it have been from 1917 to 1918?

It seems that it would hardly have been more than 20 per cent, if only because of the fact that the further the automobile goes, the smaller the untapped markets that lie still in front of it. On the other hand, it hardly seems likely that the increase for a normal year 1918 would have fallen below this figure of 20 per cent. If we assume that it would have come pretty close to this, the year would have seen the manufacture of slightly over two million cars, had not war intervened. This output we have represented by means of the shadow car in the background of our drawing, while the solid structure in front of it gives us the magnitude of the production actually attained for the year. With the normal requirements of the year added to the deferred production that must be made up, surely 1920 will be a banner year if only labor and supplies are obtainable in sufficient volume to do all the business that is to be done.

When we attempt to depict the growth of the truck industry in a graphic way, we do not have to go back to 1899. The truck is a development from the passenger car, and had to wait until the latter had passed its adolescence before it could be born. In 1904, five years after the first recognition of automobile manufacture as a separate industry, the truck was being made at the rate of only 400 per year. In 1909 it had only attained a production level approximately equal to that of the passenger car ten years before. After that it continued to enjoy a healthy growth, until in 1917 there were made in round numbers 125,000 trucks.

It will be noted that the production of trucks never comes near that of passenger cars, so far as flat figures are concerned. From 1911 to 1917 the truck production ran from 1/14 to 1/21 that of cars, with the single exception of the year 1915, when it jumped to 1/11. A fair average for the whole period seems to be about 1/16—for every truck manufactured in a normal year there are 16 passenger cars. When in the face of this we come to the war year, 1918, and find that there was one truck made for each four cars, we need nothing further to show that where the war clamped the lid down on the production of cars, it boosted that of trucks far beyond normal. In our drawing we have indicated that the attainment for 1918 is abnormal by showing also the estimated production for 1919—which according to competent authorities is somewhere in the general neighborhood of 150,000. We make no attempt to represent 1919's passenger cars, simply because we can get no estimate of their number that is worthy of attention.



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Graphic showing of the automobile production in the United States for representative years since the dawn of the industry. The shadow car shows where the estimated output for 1918 would have gone had it not been for the war, which cut it to the proportions actually shown

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Review of the Year, 1919

The World Crisis

TWELVE months ago we were rejoicing that the end had come to the great war of arms, and with glad hearts we took the sickle in hand to reap again the rich harvests of peace. Today, the clouds of disillusionment lie broad and heavy upon the world; for the clash of arms has been succeeded by a great clamor of many voices, among which are heard the shoutings of fear, suspicion, prejudice and hatred. Nevertheless, we are sufficiently optimistic to believe that the world has reached a stage of education and broad enlightenment, upon which no such general chaos and revolution as the more timorous of us have predicted can ever take place, certainly not in America. Students of history are well aware that every great war has been succeeded by a period of high costs of living and great industrial unrest. If the good sense of the majority and the unchangeable laws of economics have served to carry the world through similar crises in the past, when education and information were not so widely shared, we have every reason for confidence that all of the great peoples will weather this industrial storm and settle down to an era of steadily increasing prosperity. An attitude of reasonableness on the part of labor, of generosity on the part of capital, and a substitution of confidence for distrust will surely dissipate the gloom and let in once more the sunlight of former days.

But who shall start the world on its upward way? The Senate of the United States has it in its power, by the acceptance of the Peace Treaty, to reverse the tide of human affairs overnight.

Engineering—Electrical, Hydraulic, Etc.

Although, in the broad field of engineering, the past year has no record of startling achievement, it is certain that, when the deadlock in the world's affairs due to our Senate has been broken, some works of magnitude will be undertaken. Here in the United States we have entered upon the extension of our transit facilities, particularly in the city of New York. The necessary legislation has been secured for building a large vehicular tunnel beneath the Hudson River to provide for the ever-increasing stream of automobile and motor truck traffic. It is realized that the question of ventilation is fundamental, and the final plans will be drawn so as to secure at all times an ample volume of fresh air, with a minimum content of poisonous gases. The Channel tunnel is to be built. The last objection, which was a military one, has been removed, for under the new conditions of friendship between France and Great Britain, the tunnel, in the event of future military trouble, would be of priceless value for the rapid conveyance of troops and munitions. France and Spain are coöperating in a scheme to pierce the central Pyrenees with a tunnel 17,566 feet in

length, thus adding a third connecting line of rails between the two countries. In the matter of water transportation, it is gratifying to know that the Panama Canal is fulfilling every expectation. Over 5,000 vessels cleared at each terminal during the 1919 fiscal year. The huge slides at Culebra have reached a natural angle of repose; Gatun Lake has proved ample to supply the demands of lockage, and the whole vast scheme, including the operation of the locks and the wharves and docks at their terminals is functioning most satisfactorily. It was a banner day in the history of this enterprise when the Pacific fleet, including four divisions of dreadnoughts or fourteen ships in all, passed through the Canal from the Atlantic to the Pacific without a hitch. The New York State Barge Canal, the greatest inland waterway of its kind, is completed with the expectation of dredging out to full depth on some stretches where silt has accumulated. The equivalent of about 200 standard barges is now in operation, and the realization of the full benefits of the Canal simply awaits the construction of terminals and of a sufficient number of barges.

With the return of normal conditions, some greatly needed bridge construction will be carried out as part of various schemes of improved transit. Had it not been for the war, the Hudson River bridge, with its 3,000-foot span, would have been under construction. Good progress is being made in the construction of dry docks of adequate size, particularly for the Navy. After enormous difficulties, the Pearl Island dock, with a length of 1,000 feet, a width of about 114 feet, and a depth of 32½ feet, has been completed. This will prove to be a work of great strategical value. In addition, the Navy is now possessed, or soon will be, of some half dozen docks each a thousand feet in length, including the great Commonwealth dock in Boston. A notable engineering event of the year was the celebration on August 25, 1919, of the James Watt Centenary, and it is significant of the advance made since his day that there was put in successful operation this year at one of the big transit power stations (at 74th Street, New York) a compound steam turbine, having a total output of 100,000 horse-power. In railroad engineering there has been a steady increase in the size of units. Thus, the Pennsylvania Railroad recently exhibited a Mallet locomotive weighing 800,000 pounds, of which 580,000 pounds represents the weight of the locomotive. Coal cars have gone up to 210,000 pounds' capacity, and other rolling stock in proportion.

Very impressive has been the advance of electrical engineering. So vast are its ramifications that it may be said to lay its hand upon all engineering. The water turbine is but handmaiden to the electrical generator; a Panama Canal calls upon electricity to operate its lock gates and haul the shipping through the lock chambers; it has monopolized the mariner's compass and it bids fair, some day, to be running most of his ships.

Electric engineering work has been very largely held up by the exigencies of the war, but we have seen in the country the completion of a great dam at Maryville, Tennessee, which will yield 80,000 horse-power. Its height from the foundation to the crest is 225 feet. The ambitious scheme for developing the full head of water between Niagara and Lake Ontario by the construction of a canal along the Canadian shore of the river is being put through. The hydraulic electric plants at the Falls utilize only about one-half of the head. Those at the end of the canal will use practically the whole head of about 300 feet.

Industrial Science

In the field of applied science, the past year has been one of tendencies and development rather than of outstanding achievements that can be cited by name and date. Thus, as an aftermath of the war, 1919 will go down in the records as the year of the application of the gas mask in scores of hazardous occupations. It will be remembered as the year in which were first recognized the full possibilities of determining the physical properties of metals through magnetic analysis, without destruction of the parts tested.

At the same time, the chemist will record the year just past as the period in which an almost equal de-

gree of fineness in analysis was made general by the use of the microscope in studying the crystal structure of samples. He will also localize in this twelve months the formal recognition of the tremendous part played by colloids—almost infinitely divided substances, the diametric opposite of crystals—in the processes upon which many of our industries depend, and the consequent improved control which he has acquired over these processes. He will probably fix upon 1919 as the dividing line between the laboratory and the commercial stages in the fixation of atmospheric nitrogen.

Pure Science

If applied science can make a showing for 1919 only by exhibiting the progress which it has made on the unfinished work of other years, the case is different with the pure physicist and the astronomer. These two have collaborated during the year to effect the final step in what appears to be the overthrow of the classical ideas as to the nature of the universe; there is, indeed, little doubt that an achievement has been recorded which can be mentioned in the same breath only with the discovery of the earth's sphericity, the realization that it rather than the rest of the universe moves, and the formulation of the law of universal gravitation.

We have said something about the Einstein theories, and shall have more to say. Anything like full discussion would of course be impossible to the point of absurdity in this small space. By way of making this review complete, however, we must define the Einstein doctrines to the extent of saying that they make the numerical values of all phenomena depend upon the velocities of the bodies involved; that for the special case where these velocities are small compared with that of light—and of course this special case includes the planetary velocities which have up to recent years been the extremes within our experience—for this special case the new doctrine reduces to the Newtonian system; but that for velocities comparable with that of light—velocities which the recently acquired ability to investigate the sub-atomic world have actually laid open to our observation—things turn out so differently that we are forced to conclusions that shock our common sense, trained as this is in the old way of thinking. Mass and dimension are not constant, but change as velocity changes; time itself is not the same everywhere, but is a function of space; and neither time nor space nor force nor matter have any independent values, but are all bound up with one another, and are as meaningless without each other as is velocity without time.

There is little remaining doubt that we shall have to accept all this. But even without the Einstein developments, the past year would have been a busy one in pure science. The astronomer has pushed his inquiries into the distances and brightness and motions of the stars. Where once he was content to catalog them by name and position, and later to investigate their content by means of the spectroscope, now he goes far beyond this, and by the most ingenious of deductions tells us that the visible universe is at least 300,000 light years in diameter; that Rigel, the giant among stars so far as is yet established, is 12,000 times as bright as the sun; that some of the stars are demonstrably at least ten million years old.

Among the notable lesser items to be recorded are the observations of several astronomers which seem to indicate that the moon is not totally dead, but possesses something which answers in a way to the definition of vegetation; the rapid improvement in the spectroheliograph technique by which wonderful pictures of the sun are an everyday occurrence; the final establishment of a network of stations throughout the world in which the fine local variations of the gravitational constant will be measured with the utmost accuracy; and the announcement, as a residuary legacy of the war, that a process had been worked out and successfully employed for employing infra-red light in sending signals which can be detected only by the rankest kind of chance.

Naval

The opening of the present year found the United States Navy in an exceedingly strong position rela-

tively to the other navies of the world. A comparison of dreadnought strength showed that, if the present building programs of the various powers are completed, the United States will be stronger than the combined forces of the next three great naval powers. We shall possess 19 dreadnoughts as against 21 for Japan, France and Italy combined. Great Britain, of course, because of her superb shipbuilding effort in the great war was stronger than ourselves; but in agreement with the suggestions of our President, all of the great naval powers, except possibly Japan, have ceased capital ship construction and are merely completing some of the lesser units which were partially completed during the war. Great Britain has got rid of all her pre-dreadnoughts and armored cruisers, some of her earlier battle-cruisers, and is seriously contemplating the striking of her early 12-inch gun dreadnoughts from the list. The United States, the protagonist of disarmament at the Peace Conference, is the only navy that is increasing its naval forces, and this she is doing to the extent of building 18 battleships and battle-cruisers. The Naval Board has recommended an additional three capital ships, making 21 in all. The trials of the dreadnought "New Mexico," our first battleship to be driven by the new electric drive, were a great success. In addition to the admitted advantage of easy controllability, the ship has already shown herself to be superior in economy to our battleships using the reciprocating engine and steam turbine drive. This makes it fairly certain that the electric drive will be the drive of the future for all of our vessels. The British seem well satisfied with their mechanical reduction gear which is being utilized for the transmission of over 37,000 horse-power on a single shaft. Our new 43,200-ton battleships known as numbers 49 to 54, with 684 feet overall length, have the enormous beam of 106 feet; they will carry twelve 16-inch and sixteen 6-inch guns and have a speed of 23 knots. Our old friends, the battle-cruisers, have been greatly modified. By increasing the beam to 105½ feet, it has been possible to get all the electric and steam machinery below the protective deck without reducing the anti-torpedo protection. Displacement has gone up from 35,000 to 43,500 tons, speed has been dropped from 35 to 33.25 knots, and, we have no doubt that the armor plan has been greatly increased. These changes put our battle-cruisers in the same class as the "Hood." They will be, practically, battleships with battle-cruiser speed, and will carry eight 16-inch and sixteen 6-inch guns. Speeds have increased in every type of ship. The latest British destroyers have been showing from 37 to approximately 40 knots, this last being achieved by the "Turquoise," which steamed for four hours at an average speed of 39.6 knots.

The last few months of the year have brought forth some startling statements from high naval authorities as to the future of naval warfare and the composition of naval fleets. Lord Fisher and Admiral Scott believe that the day of the battleship has gone, and that the command of the air will mean the command of the sea. May be; but it has yet to be proved. At the same time, it is significant that Great Britain should be directing her energies and her wealth so lavishly toward war in the air. She is building seaplanes of vast size and capacity and although her original airplane program has been modified, it is still very ambitious. The revulsion against the submarine due to German misuse of it has largely subsided, and there is a consensus of opinion among naval men that this type will figure even more extensively in the future shipbuilding programs of the various navies. The type of ship most favored seems to be one of our S type, of about 850 tons displacement. Whether huge submarines of the British K type of 2,000 to 3,000 tons displacement and 24 knots' speed will be permanently adopted is a question for the future. They were built as fleet submarines, intended to cruise with the fleet and engage in fleet action. There is the question of the future of high-speed, torpedo-carrying motor boats. The British coastal motor boats, carrying one or two torpedoes on deck, and having a speed of 40 knots, seem to have acquitted themselves so well as to have become popular for work against both destroyers and submarines. On this side of the water we have seen a meritorious attempt along the

same lines in the one-man torpedo boat which, because of its low cost and comparative invisibility lends itself admirably to harbor and coast defense.

Military

The record of military achievement of the United States, particularly in the matter of the development and production of military material, has suffered from the fact that what we had accomplished could not be made known until the close of the war. But with the signing of the Armistice there came an inevitable and natural falling off of interest in things military; and it is to be feared that the many publications, reports, et cetera, which have been released by the War Department have failed to produce their full effect because of an audience that was no longer intensely interested. The files of the SCIENTIFIC AMERICAN for the past year, however, contain a very complete statement of this great work, and it is gratifying to know that if war should come again (which God forbid!) we shall not be caught unprepared in those branches of warfare which can never be extemporized—we refer to the matter of guns, shells, munition plants and general equipment. Although we could not get much of our army artillery to the front, that is, in time to exert any decisive effect, it is at least gratifying to know that we have today stored away and kept in first-class order a vast amount of artillery of the very latest types and most excellent workmanship. As to our future army, it seems likely at the present writing that it will consist of between 250,000 and 300,000 men; but back of that army we have some four millions of men, half of whom have had experience on the fields of Europe, and the other half have received a more or less adequate military training at home.

Merchant Marine

After one year of peaceful operation, in which the fruits of our great war effort in merchant shipbuilding have been utilized on the trade routes of the world, America may confidently assert that she has taken her place once more as one of the leading maritime nations of the world. This is one of the first fruits of a war which both depleted the fleets of our competitors and drove us, by the sheer force of necessity, into shipbuilding operations. It is most fortunate for us that the flower of the German fleet was driven by the British cruisers to take refuge in our ports, for we entered the field of foreign commerce with a fleet of first-class ships ready to hand. The vessels which are built and building by the Shipping Board were designed for war service and a revision of plans has been necessary. A large percentage of the smaller ships, including those of wood, have been sold or are upon the market, and the vessels that are now planned will be much larger and of higher speed.

It is doubtful whether for many years we shall see upon the ocean highways any passenger vessels larger than the "Leviathan" and the "Aquitania," or faster than the "Mauretania," which holds the blue ribbon of the Atlantic with her speed of a little over 26 knots. Profits do not lie in such vessels, with their huge coal bill and very limited freight-carrying capacity. Until some new form of motive power is introduced, shipping companies will be content with a maximum speed of about 20 to 21 knots. Of equal importance with the building of ships is the provision of port facilities. We need to adopt the very latest mechanical cargo-handling devices, and in New York we require a thorough revision of the whole plan and scope of our docks and docking facilities.

Aeronautics

Save for the year in which the Wright Brothers made their first flight in a power-driven man-carrying airplane, the year just passed must rank as the most notable in the era of aeronautics. With all the rich experience of the war to draw upon, the art of peaceful commercial flying was certain to make great strides. First, in the early summer, came the flight of "NC-4" from the United States to England by way of Newfoundland, the Azores, Portugal and Plymouth. The success was achieved through a carefully planned and highly cooperative effort of the Navy, which had five battleships and scores of destroyers and tenders strung

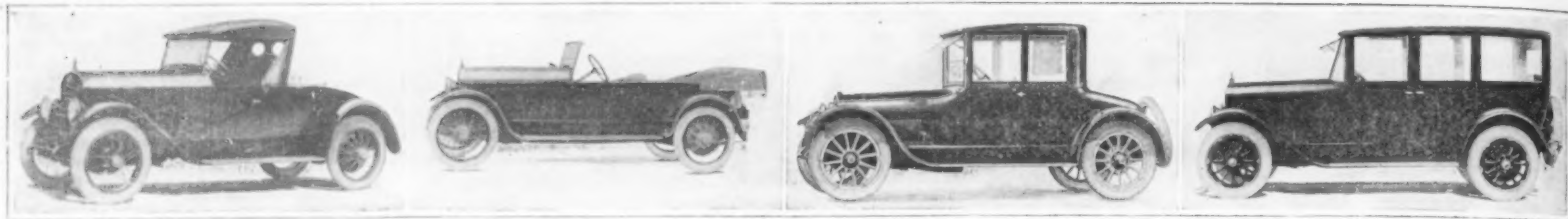
across the Atlantic. Then followed the amazing flight in less than sixteen hours of Alcock and Brown from Newfoundland to Ireland in their Vickers-Vimy bombing machine, driven by two Rolls-Royce engines. These young men had their luncheon in America and their breakfast next morning in Europe. To the same remarkable machine is to be given credit for winning the race from England to Australia, a distance of 10,000 miles, in thirty days. Another epoch-making flight was that of the dirigible "R-34" from England to the United States and back. An event which excited world-wide attention was the great race across the American continent from Mineola to San Francisco and return, made under the auspices of the Army. The winner, Lieutenant Maynard, stayed for 48 hours at San Francisco and reached the Atlantic coast again in ten total days of daylight flying. His average speed was about 110 miles per hour. The leading positions were taken by army fliers using the "DH-4," which is driven by a Liberty motor.

A striking development of the year is the great increase in size and power of the large airplanes suitable for bombing in war and for passenger-carrying in times of peace. The Caproni triplane which made a flight from Villacoublay, France, to London with a number of passengers, has been remodeled for passenger service and carries eight passengers, with three additional seats for pilot and mechanics. The largest Caproni is a triplane which, fully loaded, weighs about 25,000 pounds and is driven by five 290 horse-power engines. This has a double-deck cabin and accommodation for 22 passengers. The Vickers-Vimy has been remodeled and is carrying ten passengers. The Farman "Goliath," which is making regular passenger trips between Paris and Brussels, carries ten passengers at a time, and with this aboard has attained a height of 10,000 feet. The Handley-Page four-engined biplane, which was sent to Newfoundland for the trans-Atlantic race, is now in the United States and has been fitted for passenger accommodation. She is credited with having accommodation for thirty passengers. Another huge machine is the Bleriot four-engined machine, with accommodation for twenty-eight passengers. Commercial flying in Europe is well established and showing rapid development. Regular passenger planes make daily trips between Paris and London in between 2¼ and 2½ hours, and there is a service from Paris to Brussels, beside several local services within the various countries.

Here in America, although the work of nationalizing industry makes pitifully slow progress and the matter of governmental assistance is still in the talking stage, the private builders have been doing some very fine work. We hold in the United States the record for altitude, which was won by the Curtiss "Wasp," a small high-power triplane, originally designed for war work. It has climbed to 34,610 feet, and also it holds the American record of 163 miles per hour straight-away, with full military equipment, including four machine guns. Some excellent passenger-carrying cars have been developed, notable among them being the "Lawson," a ten-passenger machine and the Curtiss "Eagle," carrying eight passengers.

With regard to dirigible service, the great risk which these vast machines encounter, when they land upon the ground and while they are there, has been obviated by the use of tall mooring masts, up to which the dirigible noses and makes fast, riding to the wind. In a test carried out under British Army supervision, a dirigible 540 feet in length was kept moored to one of these masts for six weeks of more or less rough weather without receiving any injury.

As showing how reliable passenger service has become, the *London Times* reports that Airco express airplanes, which fly daily between London and Paris, have completed the sixth week of continuous operation, having accomplished 83 out of a total of 86 flights without stoppage or breakdown. Furthermore, it is stated that only once during the 20,750 miles of flying has one of the pilots had to alight because of mechanical trouble. Toward the close of the year, reports reached us of the remarkable speed accomplished by Lecoq, the holder of French records, who covered a kilometer at a speed of 190 miles an hour.



Three-quarter side view of a typical 1920 roadster, which emphasizes the high hood and the long straight lines of the new body types.

A snappy four-passenger speedster touring model, which retains the general lines of a typical roadster.

The Coupe is a closed car type that is becoming deservedly popular. The types for 1920 are graceful in appearance and well appointed.

A new type, the Limoudan, so named because it combines features of both the Sedan and the Limousine.

A pictorial chat on what the body designers and builders have done for the 1920 car

The Refinement of Details

The Trend of Design for 1920 Shows No Radical Changes, but Many Improvements to Mechanism and Bodies

By Victor Pagé

WHILE national automobile shows were held last year in both New York and Chicago, they were not manufacturers' exhibits but a showing of models by dealers that had few novelties or improvements in the car mechanism; but some changes in body designs were made and a new aspect for 1918 was given the models of 1917 by such changes. Automobile design has progressed to a point where radical changes cannot be looked for as in former years and even when new cars are offered, they make their appeal because of conservative design rather than attracting public attention by incorporating changes in mechanism that are out of the ordinary. The makers of the few new passenger cars announced for 1920 production are not making claims for any departure from the standards previously established but are making a bid for public favor by pointing out how refinements of detail have been made in the chassis and power plant as well as in body designs.

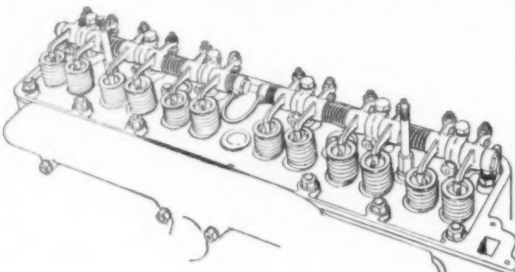
The power plant situation is practically unchanged as relates to the number of cylinders, the four-cylinder engine still being supreme as far as numbers produced are concerned, the six-cylinder coming next and lastly the eight- and twelve-cylinder V-engines. No appreciable gain for the two latter can be noted, in fact there is a slight decrease as some makers who formerly had both V-engine and six-cylinder models have continued the latter in preference to the former. Carburetion and ignition troubles have been minimized to such an extent that they no longer constitute a problem and low volatility fuels have been taken care of successfully by changes in construction that give us hotter running engines than would have been desirable or even considered practical in years past.

The remarkable point is the degree of refinement of detail one notes in even engines of cars designed for large production. Counterbalanced crankshafts are found on a number of four-cylinder engines of recent development and contribute to the smooth running qualities of these simple and satisfactory power plants. Machined and balanced connecting rods and accurately finished pistons reduce vibration due to reciprocating parts and make high speeds possible that permit of lower final drive gearing than formerly used and a better performance on the high speed or direct drive gear. The lubricating systems have been materially improved and this has made high piston speeds practical and desirable. There is a marked gain noted for

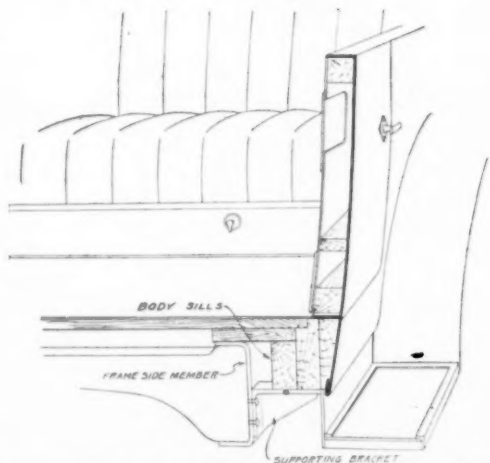
the overhead valve principle and engines that do not have readily removable cylinder heads are a rarity.

Beauty Plus Convenience

A point noted is the exceptionally clean external appearance of most 1920 engines. The components are located in very accessible positions and are simple in



Rocker arms on the latest example of 1920 overhead valve engine



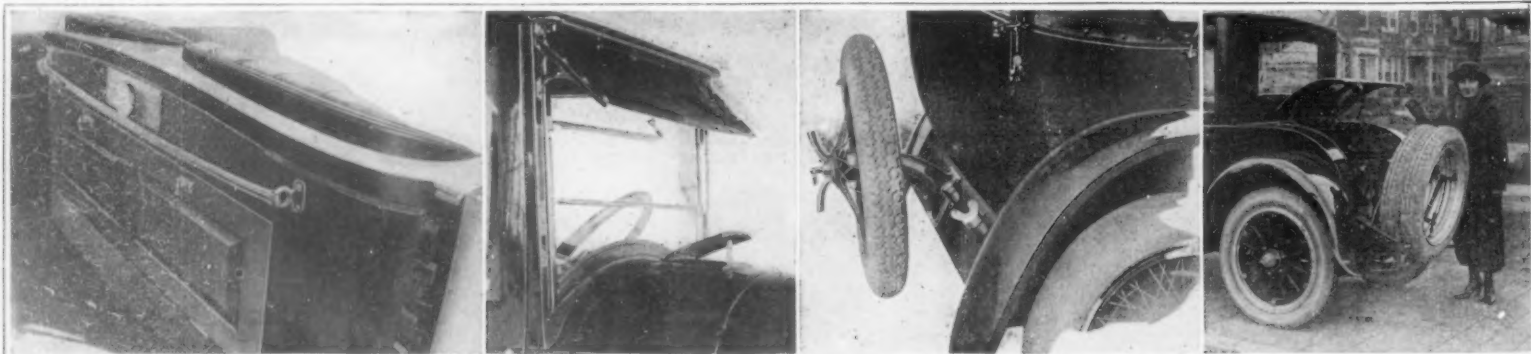
Construction used in lowering the body sides without sacrificing the road clearance

form. All working parts are thoroughly enclosed and everything that needs oiling about the power plant is included in the automatic lubrication system of the engine, excepting a few minor parts that do not need constant oiling. Even the rocker arms of overhead valve engines now have their important center bearings oiled automatically by circulating oil through a hollow shaft.

A further refinement noted in the overhead valve mechanism is found in the ease with which the push rods may be removed without disturbing any other part of the mechanism, or, in fact, without removing any part of the engine except the detachable overhead cover. Spring spacers are provided between the rocker arms, permitting the latter to be pushed to one side, after which the push rods, which form ball and socket joints with their adjacent members both top and bottom, may be freely lifted out.

With a view to improved carburetion, the intake manifold of several power plants, both on overhead-valve and L-head types of engine, is cast entirely within the detachable cylinder head, connection with the carburetor being effected by an integral cross passage between the third and fourth cylinders, to the opening of which is bolted a short elbow supporting the carburetor. A small portion of this elbow is integral with the exhaust, forming a hot spot of limited proportions to assist in breaking up the fuel before it enters the manifold.

Care has been taken in designing the intake manifold system to secure the application of heat in just the correct proportion, i. e., to secure satisfactory performance on low-grade fuels without undue thinning of the gases and consequent loss of power. That complete success has been attained in this respect is attested by the performance of one of the engines, 71 horse-power being developed on low-grade fuels at 2,600 engine revolutions, though the N. A. C. C. rating of the engine is only 29.4 horse-power. Other features looking toward greater accessibility and convenience in inspecting and adjusting the typical 1920 engines are found in the arrangement of the operating accessories, such as carburetor, generator, water pump, starting motor, spark plugs, manifolds, etc., all of which are grouped on the right hand side of the motor illustrated, which may be considered typical. The engine compartment is fitted with a motor light under the hood for night illumination.



1. Large compartment back of the front seat in some 1920 models. The electric bulb in the center of this panel is an extension lamp and serves as an inspection or trouble lamp as well as for lighting the tonneau. 2. The patent leather visor over the windshield of this sedan affords protection to the driver against the hot rays of the sun and the disturbance of vision through rain and snow alike. Note the open cowl ventilator. 3. A new tire holder used on a well-designed car. This holder accommodates wire or disk wheels or spare rims and makes the spares easy to put on or take off, as is obvious from its construction. 4. An unusually large and locked storage compartment in the afterdeck of a new four-passenger coupe, enables the carrying of a couple of suitcases, handbags or other luggage with convenience and safety.

Some novel features of the 1920 automobile which make for greater comfort and convenience

Some Motor Details

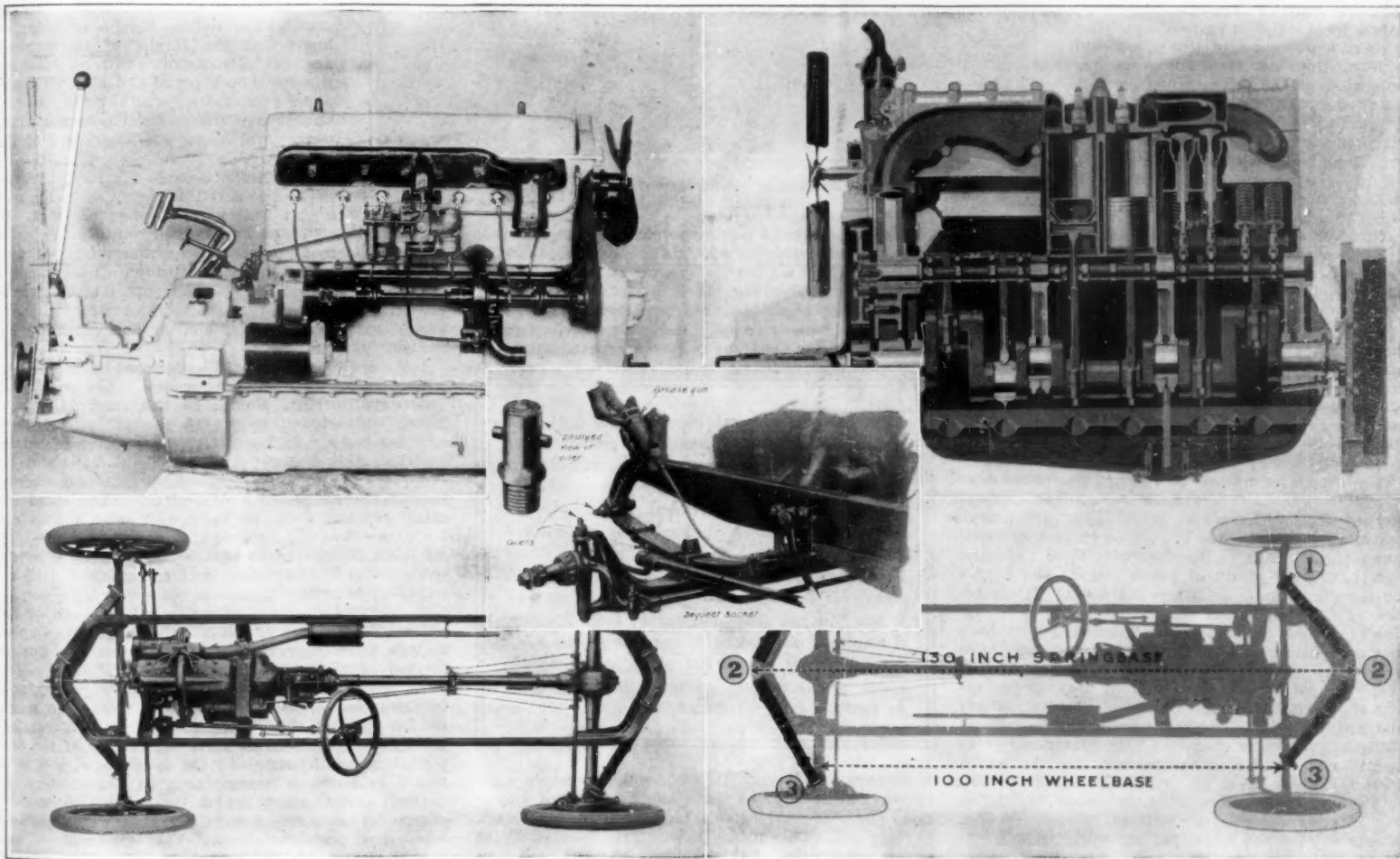
Another well developed motor in which a number of new and valuable features are incorporated is shown in sectional view herewith, the attention of the reader being especially directed to the novel cylinder head construction and valve arrangement. The motor has a detachable aluminum head in which are cast not only the usual water jackets, but also all passages of the horizontal intake manifold. The horizontal carburetor is bolted directly to the head. The combination of the intake manifold with the motor head not only shortens the distance from the carburetor to combustion chamber, but also allows intake passages to be heated directly from the combustion chamber itself. These intake passages are inclined downward from the point of contact with the carburetor, so that any unvaporized particles of gasoline leaving the carburetor will be forced to flow down hill and into a position directly in contact with the combustion chamber. The disadvantages of low grades of gasoline now in general use which prevent complete carburetion and result in the presence of a certain quantity of raw or un-

multiplied action of the bell cranks, a 5/16-inch lift of the valves is obtained from 3/16-inch cams. Being placed at an angle, the adjusting ends of each valve stem are in the most accessible position. A feature of the motor is the convenient and compact accessory unit on the right side. This unit comprises the generator, oil pump and distributor. The entire group is removable as a unit. All bearings of this group are lubricated through an opening in the side of the crankcase by the splash from connecting rods. The coil and relay are mounted on the generator.

Space is not available to outline the many refinements that have been made in motor construction but these may be summarized by saying that automatic water circulation control and heated gas manifolds are found in many power plants on account of the low-grade fuel now used. Ignition is by battery and coil on practically all cars. Oiling is by forced pressure feed in all instances. The interior parts of the engine that reciprocate are better finished and balanced and every attention is given to compact grouping of accessories.

comfort is claimed by the makers for this unconventional spring arrangement.

A marked improvement is also noted in several chassis in the method of greasing spring shackles, steering knuckle pins and various bearings on the chassis that were formerly neglected or provided with inadequate oil cup or grease cup lubrication. A new pressure system has been devised in which a powerful screw plunger grease gun forces the grease through a flexible metal tube to special oilers designed to permit of rapid attachment of the feed tube by a bayonet lock arrangement as is used with lamp bulb sockets. The opening is closed by a ball check valve which seats automatically when the connection is removed. Every effort is now being made to eliminate squeaks due to unlubricated bearings by providing lubricant impregnated bushings at bearings for control shafts and at various points in the chassis that are hard to reach by ordinary methods of lubrication. Special forms of simplified frame designs eliminate frame squeaks and body construction also has been improved to prevent noise. Chassis and body squeaks are now espe-



Upper left: An example of how many of the 1920 engines group all the accessory mechanisms, such as manifold, spark plugs, carburetor, pump, generator and starting motor, on the one side, yet leave them all accessible. Upper right: Sectional view of typical 1920 six-cylinder engine, showing thermostatic control of cooling system, and inclined valves. Center: New system of lubricating the chassis parts by positive-feed grease-gun and special bayonet-lock oiler. Lower left: Plan view of a 1920 chassis, showing new spring suspension that gives a long spring-base for a moderate wheel-base. Lower right: Further comparison of spring-base with wheel-base in the same design as shown at left.

Some of the outstanding details of the 1920 trend in passenger cars

vaporized gasoline in the manifold are overcome by this type of construction. By the position of the valve openings, gases immediately upon passing through the valves are directed against an unjacketed and therefore superheated portion of the combustion chamber head. This insurance of complete vaporization and perfect combustion contributes greatly to the fuel economy and likewise prevents the impairment of lubrication by the seepage of raw gasoline past the pistons into the oil reservoir.

Another novelty of the motor design is the arrangement of the valves, which are inclined at an angle of 20 degrees, instead of being in the usual vertical position. Because of this angular position, gases pass more freely to and from the combustion chamber, thereby reducing heat losses and giving quicker and better combustion. The valves are operated by bell cranks with roller contacts on the cams, instead of the ordinary mushroom type of push rods. This valve operating mechanism gives a degree of quietness which is not obtainable in push-rod construction. By the

The clutch designs that are the most popular are the simple plate clutch forms in which one large metal friction disk is clamped between asbestos-faced driving members and the simple cone clutch. Intricate multiple disk-in-oil forms are losing favor because they cost more, demand more attention and do not have any marked advantages over the simpler, dry plate or cone forms. Gearsets are all of the three-speed selective form and unit power plants are almost universally used.

Chassis and Bodies of the Year

The most striking novelty in connection with chassis design is the spring arrangement of a new light four-cylinder car that is to be produced in large quantities. As illustrated, the springs, which are of the quarter elliptic form, are attached to projecting triangular cross members at the front and rear of the frame so a greater spring base is obtained without having a long wheelbase. The springs are attached to the axles at points 1 and 3 and to the frame at point 2. Greatly improved suspension and a marked increase in riding

comfort is claimed by the makers for this unconventional spring arrangement.

Many detail improvements are noted in body construction. These are designed to give maximum comfort and have many appointments that are really luxurious. The low, sporty looking straight side roadster or four-passenger car is easily the favorite in open body designs and usually, wire or metal disk wheels are used on cars that are intended to be really stylish instead of more popular and generally used wood spoked forms. Every effort is being made to lighten the cars for 1920 and as a rule, the body and chassis weights will be considerably lighter for a given capacity than in years past. An increasing use of aluminum and pressed steel is noted to secure lighter cars, as it is now generally recognized that it is the balance and not the weight of a car that makes for easy riding and there is no reason for carrying extra weight if it can be eliminated without sacrifice of strength.

In the body, numerous improvements are likewise

(Continued on page 22)

The Romance of Invention—VI

Hudson Maxim: Inventor, Scientist, Lecturer, Poet, and Man with the Courage of His Convictions

By C. H. Claudy

IT is the versatility of Hudson Maxim, rather than his attainments, great as these unquestionably are, which has always made the greatest appeal to the interviewer hunting for the "picturesque angle." Time after time Mr. Maxim has been "written up" for some newspaper or magazine, and time after time the scribe has patiently dug up all the "human interest" facts he could find (and he could find a-plenty) and written stories which laid distress on all the spectacular and unimportant things about the dynamic driving force which goes around under the name of Maxim.

Item, he is sixty-six years of age. Item, he plays a fine game of tennis, although he learned it less than ten years ago. Item, although he has but one hand he is a crack boxer, and not at all afraid to try conclusions with any one of his age, and probably not with any one of any age. Item, he loves sports, canoes, shoots and drives a car as skillfully as if he had ten hands instead of one. Item, he has a voice like a fog-horn and when he wants anything or any one, shakes the atmosphere like one of his own bombs until it or he (or she) arrives. Item, he has invented a hundred different things from canned food to smokeless powder, from a method of improving roads to a scientific way of writing poetry. Item, he is a patriot not afraid to get up in meeting and say what he thinks whether what he thinks is what the other fellow thinks or not. And so on, with a few dozen more items of similar picturesque import.

But it appears to the present writer that the usual interviewer in search of "material" loses sight of the substance in chasing the shadow, fails to see the woods for the trees and allows the interesting unimportant details completely to obscure the much more interesting whole. There have been other men of sixty-six years with a young man's body. There have been other men with one hand who refused to allow a mere physical loss to interfere with their activities. There have been plenty of tennis players and boxers who were remarkable as boxers and tennis players because of their age. But there have been few if any scientists whose contributions to knowledge have been great enough to give them world-wide fame, who have been able to excel in so many different lines of labor.

Yet it is neither his versatility in life, nor his variety of interests, his wide range of abilities nor his constructive thinking which are really the keynote to a truly extraordinary character. Mr. Maxim excels in a great many different things, but the one which stands out above them all is his moral courage... his absolute fearlessness when it comes to stating what he knows or what he believes, in the face of a contrary opinion not individual but world wide.

There are a hundred instances of this, crowding for expression here, but the writing of "Defenceless America" and the production of the motion picture "Battle Cry of Peace" will suffice for the moment. Other men have told America what was the matter with it, but never any one with the same amount of vigor and "punch" that Mr. Maxim did. Other men have made motion pictures hoping to help along preparedness, but none were in the situation in which he found himself. For Mr. Maxim is the inventor of smokeless powder, of various kinds of explosives and time fuses and other weapons, and had fearlessly to face the criticism of those who are always looking for the "hidden motive" and who were unable to see that a maker of weapons of war could have any other reason for trying to get America to prepare than a desire to sell his products.

The criticisms made Mr. Maxim's friends laugh. They knew him so well as a hater of war and all that war means. But for every one who knows him are a million who never met him. But that mattered not at all... he wrote his book, gave thousands of copies of it away, sold thousands more, and succeeded



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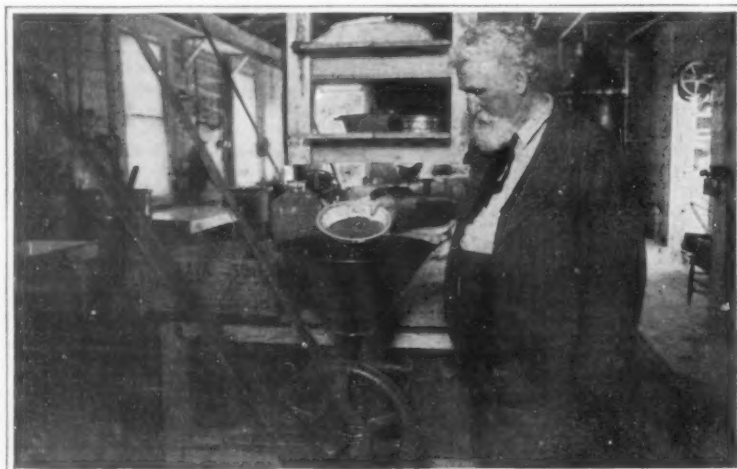
The inventor of smokeless powder experimenting with soya beans to produce a new food

pretty thoroughly in waking people up to the fact that a pacific unpreparedness might be a good thing in heaven but was nothing to brag about in a world that had a Germany running amuck.

Mr. Maxim began showing moral courage of a high order when he was a young man. He regards a paper appearing under his name in the SCIENTIFIC AMERICAN

IN the case of most inventors who have made their mark, we can identify the field in which the best work has been done and apply the title chemist or electrician or pioneer in aviation in conjunction with that of inventor. Many people think of Maxim as an expert in explosives—but he has done work in several other fields which he himself values above his powder innovations. Really his interests are so broad that if we wish to give him any other designation than inventor, it must be a more inclusive one rather than a less inclusive. Mr. Claudy has caught admirably the spirit of this human dynamo in the story which he presents here.—THE EDITOR.

SUPPLEMENT of May 11, 1889, but which he wrote when he was but twenty-two years old, as the most important, most far-reaching and most vital piece of work he ever did. This paper, titled "Principles of Force and Demonstration of the Existence of the Atom" demonstrated also the conviction of its author that a great name was no reason for not disagreeing with its



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Hudson Maxim at work in his food laboratory, the center of his interests at the present moment

owner. For here a young man with his reputation yet to make in the scientific world calmly disputes with Herbert Spencer, quotes him at length and then proceeds to show, logically enough, where the great thinker was mistaken. That took courage, and courage of a high order.

The scientific world has come to the conclusion Mr. Maxim reached in his publication. He reached his convictions through a process of reasoning. The scientific world has arrived at the same conclusion through the balance and the test tube. It must be of considerable gratification to the Maxim of today to know that the Maxim of thirty years ago could demonstrate, with no other apparatus than a pencil and his own brain, some fundamental facts regarding the structure of the material universe which were years ahead of the science of the laboratory.

Mr. Maxim regards his book "Science of Poetry and Philosophy of Language" as his next greatest piece of work. If you ask him why and how he can consider this as of greater import than smokeless powder, he will very likely tell you that any one of a dozen chemists might have made a smokeless powder, but that he was a pioneer in reducing the compositions which we call poetry to their elements, and in demonstrating his analysis as scientific.

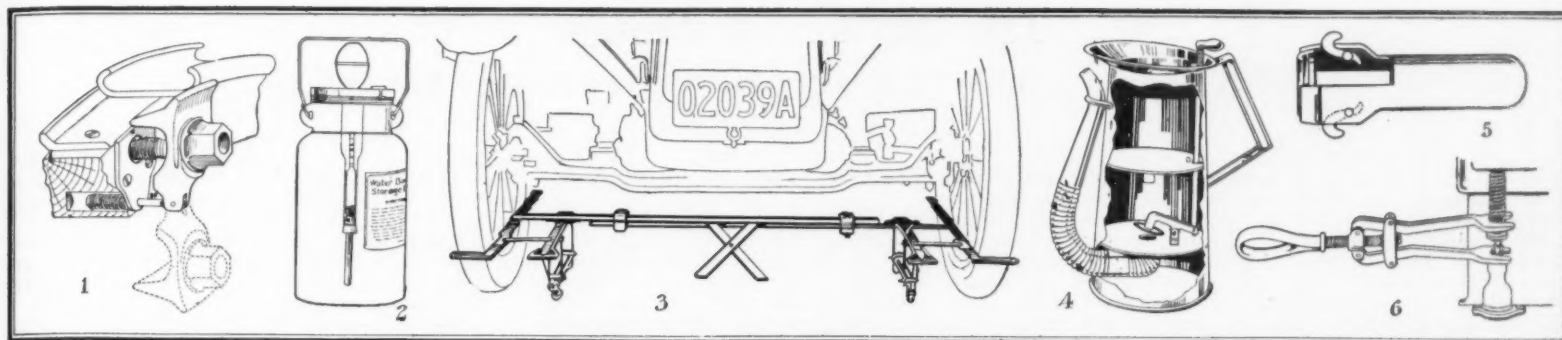
For some reason not well understood by the present scribe, the several writers whose "interviews" and "write-ups" of Mr. Maxim he has read, have completely missed the fact that the subject of their sketches has a very keen, if very dry, sense of humor. Perhaps it is because they didn't take the time to delve into any tome so forbidding in title and sober in appearance as "Science of Poetry." Yet there are many chuckles awaiting the reader, and a keen ear for satire does not have to wait long in conversation with Mr. Maxim to be gratified with some excellent examples of how wit can puncture bombast. It is recalled of him that in one of his public speeches, he was preceded on the platform by a gentleman of the old school of oratory who wound his audience up to a high pitch of excitement by the usual oratorical method of waving arms and greatly stressed voice, rising and falling, now in anger, now in pathos, now in denunciation. Mr. Maxim, who desired to speak on the opposite side of the matter under discussion, got up and proceeded to prove the futility of the oratorical method by repeating the vowels a, e, i, o, u, w and y in tones so heartrending, so denunciatory, so pathetic and so angry, and in such complete mimicry of the high-sounding but rather meaningless phrases which had just been uttered, that his audience was convulsed and his predecessor completely eliminated from serious consideration.

Mr. Maxim has been a public speaker and a lecturer of prominence for years. He would probably resent having it said that much of his success in that line came from his picturesque and vigorous methods, but his own book proves that it is the function of language to impress as well as to express, and Mr. Maxim has learned both functions very thoroughly.

Hudson Maxim is not the inventor of the Maxim gun nor the Maxim gun silencer. Sir Hiram Maxim, a brother, is the inventor of the machine gun which bears his name, and a nephew is the inventor of the silencer. Hudson Maxim has invented a great many things... just how many he doesn't quite know, though a stentorian yell for his secretary and the request for a list of his inventions would probably produce the information. But his greatest inventions... not in his own eyes but in those of his Government, are in the line of explosives.

Mr. Maxim knows explosives as well as any man living, and, if you take his own word for it, in some respects better

(Continued on page 22)



1. An improvement in lugs for holding demountable rims. 2. Holder for distilled water and hydrometer. 3. Gage for lining up the wheels. 4. An oil can that puts oil where it is wanted. 5. Quick-action dust-cap for tire valves. 6. Valve lifter.

Novelties which lighten the task of keeping the automobile in trim

Making the Automobile Complete

Some Interesting Motor Car Accessories for the 1920 Market

THE number of automobile accessories that are devised every year is legion and while many have a real field of usefulness, there is an equally large number that have no real reason for being and that are of doubtful utility, except as ballast. The task of selecting novel and valuable accessories from the mass available is not a pleasant one for the novice motorist as he is apt to purchase a number of devices he will find but little use for. The appliances illustrated in accompanying plates are of recent development and are really meritorious.

There is one annoying point in connection with changing a demountable rim and that is the liability of dropping the lugs into the mud or slush when they are

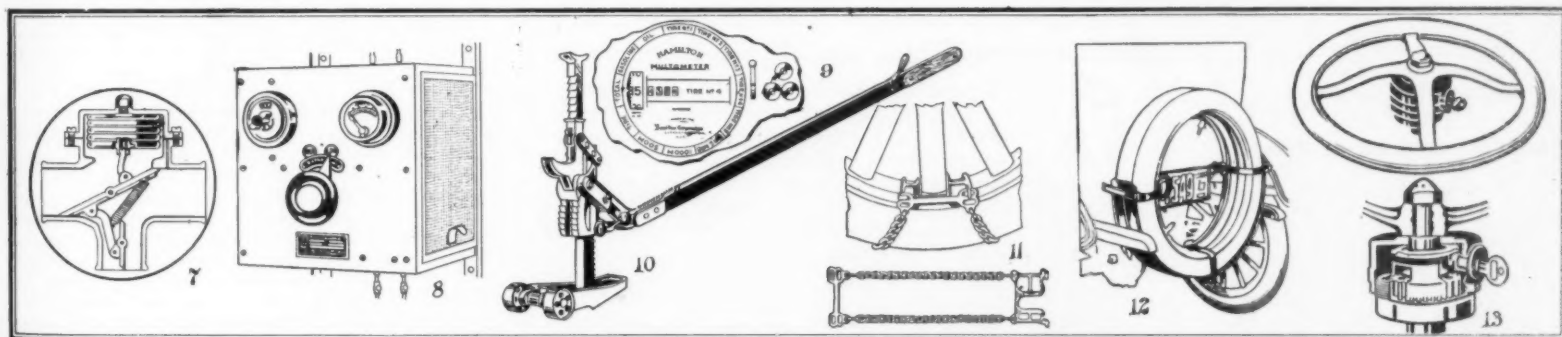
of the liquid and also serves to hold the hydrometer syringe that is so useful in testing electrolyte or introducing water into the battery cell jars.

One of the factors that promotes tire-depreciation is improper adjustment of the front wheels and their alignment with the normal path of car travel. A gage that makes it possible to line up the automobile wheels very accurately and secure easy steering as well as lessening tire wear is shown at 3, which also outlines the method of using it.

The oil filler openings of automobile engines are not always located in accessible places and it is often difficult to pour the oil in with the ordinary measure or funnel. The combined funnel and measure shown

tire. This practice results in dust working into the valve and causing air leakage or rusting and damage of the valve parts. The quick action dust cap shown at 5 is designed to offer all the protection afforded by the threaded style and offers the added advantage of quick application and removal. To install, the cap is simply pushed down over the valve stem and the spring-actuated pawls catch in the thread and hold the cap in place. To release, the spring pawls are pressed out of engagement by pushing in their exposed ends with the fingers and the cap is easily lifted off.

A new valve lifter, which is shown at 6 will prove useful to the automobile mechanic or to the motorist



7. Motor thermostat which regulates water circulation. 8. Simple rectifier for charging storage batteries. 9. Combined speedometer and recording device. 10. Extension-handle jack. 11. Quick detachable non-skid chains. 12. Combination tire holder and bumper for light cars. 13. Steering-column lock.

Accessories which make automobilizing safe and pleasant throughout the year

removed from the bolts. The swiveling lug as shown at 1 is designed so it can be easily removed from the rim-retaining bolt and swung down out of the way without any danger of loss because it is securely held to the wheel felloe by a retention pin and spring in the manner indicated.

One of the important points in connection with the care of the storage battery is the periodical replenishing of the water evaporated from the electrolyte. It is also necessary to test the specific gravity of the solution from time to time to make sure the battery is properly charged. The combination shown at 2 is very useful as it consists of a jar to hold distilled water, provided with a cover that keeps foreign matter out

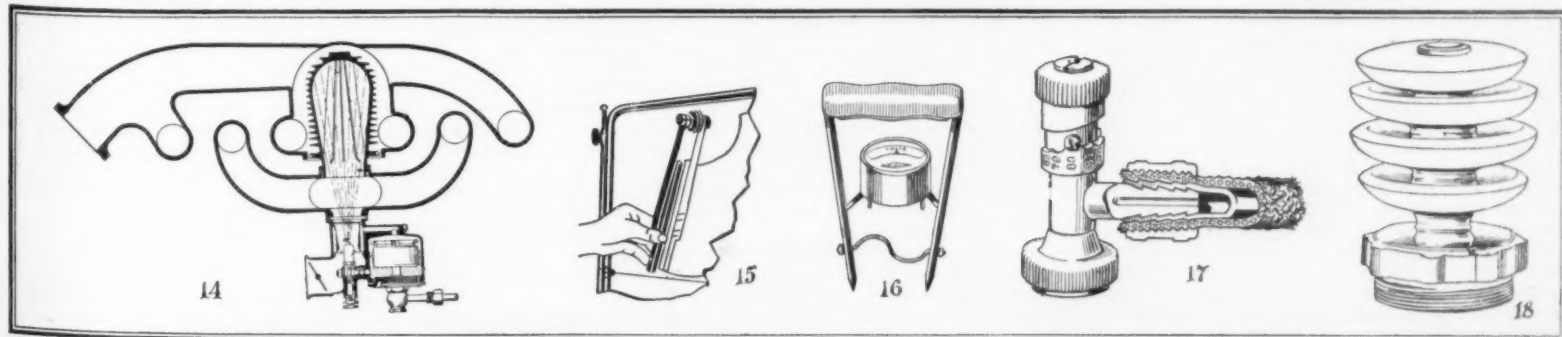
at 4 is a recently devised accessory that is equally valuable to the car owner or garage proprietor. The spout is made of flexible tubing and the delivery opening is controlled by a valve so only the desired quantity of oil may be supplied. This valve is easily controlled by a lever close to the handle of the measure. All the oil passing out of the measure is screened by a wire gauze baffle plate through which it must pass. With the valve closed, the measure may be used in the ordinary way and oil poured out of the top.

Many motorists run their cars without putting the dust caps on the tire valves because of the time it takes to screw the cap down and remove it when it is necessary to gain access to the valve for inflating the

who enjoys taking care of his own car. As the ends that spread apart to compress the valve spring are actuated by a thread and inclined plane arrangement, the stiffest valve spring may be compressed with ease and the valve spring collar retention key may be easily removed or inserted, as the case may be. The lifter will keep the spring compressed as long as necessary and enables the operator to use both hands in removing the valve.

The motor thermostat shown in section at 7 is very useful in these days of low grade fuel because it allows the motor to "warm up" quickly in cold weather by regulating the circulation of water through the

(Continued on page 26)



14. Heating system for using heavy fuels. 15. Windshield cleaner for rainy weather or snow. 16. Storage battery tester. 17. Combined tire inflating and automatic relief valve. 18. Radiator alarm and condenser for steam.

From fuel heaters to water coolers—from windshield wipers to tire gages

The Nature of Things

Einstein's Theory of Relativity; a Brief Statement of What It Is and What It Is Not

By John Q. Stewart, Ph.D.

THE new Einstein theory of relativity deals with the fundamental nature of space, time, and gravitation. It has been called the greatest advance in physical science since the work of Sir Isaac Newton; because space, time and gravitation are among the bases of physical science. A full account of the discussion which took place at the meeting of the Royal Society in London on November 6th has not yet reached this country; cablegrams to the press stated that the Einstein theory was characterized as epoch-making. Naturally public interest has been aroused; perhaps all the more strongly because of newspaper declarations that only twelve persons in the world understand the new theory. Many "explanations" of it that have appeared have hardly succeeded in enlarging this narrow circle of twelve disciples.

If the discussion which follows seems to the reader slow in coming to the point, he will please be patient. Definite statements will be made of what the Einstein theory is and does; but first a certain amount of introductory material is essential, in order to prepare a popular audience for an unfamiliar subject.

A complete explanation of anything may be said to divide itself into four parts, namely, the *when*, the *how*, the *what*, and the *why*. The present writer is honestly anxious to clarify rather than to cloud the public understanding of relativity, and he can only hope to succeed by placing the emphasis upon the "what" and the "why" of the Einstein theory, rather than upon the "how." It is exceedingly difficult to follow in detail the mathematical reasoning by which Einstein reaches his results; indeed, our respect for the human intellect is somewhat increased by the knowledge that there actually are as many as twelve people who do understand the mathematics. After all, however, the matters of chief interest are the results themselves, and their probable influence upon physical science and its applications.

What Difference Does It Make?

Precisely at this point the popular writer on relativity meets with another difficulty, which will be a fatal one, if he is not careful. He may succeed in dodging the mathematics, and he may "get by" with only the crudest representation of how relativity was worked out, on the plea that the public doesn't care how complicated the machine is, provided it produces the goods—but then he runs up against the fact that relativity has not produced any goods, from the layman's standpoint. To the latter its present practical results seem trivial accomplishments for a theory said to be so novel and revolutionary.

For instance: "A canalboat is moving upstream at a speed of three miles per hour. A man on deck is walking toward the bow of the boat at the rate of two miles per hour. What is his velocity with reference to the shore?" "Five miles per hour," your answer. "Only 4.999999999999999 miles per hour," is the reply of the student of Einstein. Or, again: "The engineer and conductor of a railroad train set their watches by the watch of a train despatcher. When the latter's watch says twelve o'clock what o'clock has the former?" "Twelve, precisely," says common sense; but relativity declares that the problem cannot be solved unless we know the length of the train, its velocity, its distance from the station, and the position and velocity of the questioner, which, according to common sense can have nothing to do with the question at all. However, the correction would not exceed a million-billionth of a second.

It is necessary to emphasize the fact that when the velocities entering into any problem are those with which we have to deal in ordinary life, or indeed in most scientific experiments and astronomical observations, then the theory of relativity has little or no application; because the peculiar effects it predicts are then so excessively tiny. It is when we deal with material objects having velocities comparable with that of light (186,000 miles a second) that the effects due to relativity are important. Such velocities are encountered only in special laboratory experiments, which are of interest only to the serious student. For the purposes of the present discussion it is sufficient to state that the results of all such experiments

are believed to be in accord with the principle of relativity.

The reader will have perceived the apologetic nature of this paper thus far. The statement was made at the beginning that the Einstein theory is "epoch-making;" but immediately thereafter we side-stepped (for the time) the mathematical basis of the theory, on the ground of difficulty; and we followed by deprecating the practical results of the relativity hypothesis. It is high time, therefore, that progress were made toward settling forth reasons for the importance of the theory of relativity.

The Significance of Relativity

These are three, in the view of the writer. First, even though the effects predicted by the new theory are too minute to be of importance in practical life, in those cases which physicists have studied hitherto, nevertheless new arrangements may some day be devised which will enormously magnify these "relativity effects." Scientists and engineers have built up the enormous electrical industry of today, starting from knowledge of the ability of amber, when rubbed, to attract light objects—an apparently insignificant fact known to the ancient Greeks.

The second reason for the importance of the Einstein theory is that it does account for numerous phenomena which otherwise are not explained. True, as has been stated above, these phenomena are of no "practical" interest; even to understand a description of many of them requires a course in optics and electricity. Nevertheless, the phenomena exist, and the Einstein theory explains them; and in the development of science little causes often give rise to great effects.

FOURTEEN years ago Einstein put forward a new philosophy of things, designed as a possible substitute for the old system based on the ideas that bear the names of Euclid and Newton. He stated at the time that his treatment was so different from the classical one, and so mathematical in its nature, that he supposed there were at most twelve living men capable of appreciating it to the last word.

Professor Russell has already told the SCIENTIFIC AMERICAN readers of the apparent verification of Einstein's theories. A bit later, on our editorial page, we tried to make clear why we may properly be asked to discard so much that we have always accepted as axiomatic. Dr. Stewart now speaks from the viewpoint of the mathematical physicist, and suggests how those of us who are not of the chosen twelve may best attempt to visualize the major content of the Einstein doctrine.—THE EDITOR.

The third, and chief, reason for the value of the theory of relativity is that it brings into relation diverse phenomena of the first importance, which hitherto had to be considered separately. The development of physical science has always proceeded in this fashion; and every successful scientific theory carries us nearer complete realization of the unity of nature. Scientists may be likened to story-book detectives who are investigating the operations of a concerted gang of criminals, and who are always seeking to identify the "man higher up." The activities of underlings in the underworld are of interest to the detectives chiefly as they throw light on the methods and identity of the leaders of the gangs. It is rarely that the latter can be apprehended by the careless observer, they are too clever for that. But the skillful investigator can infer much from the presence of a thumbprint, or the absence of a footprint; and when at last a master criminal is caught, then the forces of law and order possess the key to a multiplicity of happenings that otherwise puzzled them to distraction.

Thus Einstein: he found physicists engaged in the attempt to describe phenomena by relation to such concepts as space, time, inertia, gravitation, light, electricity; and he showed that space, time, inertia, and gravitation can be considered merely as different aspects of a single unity. This unity he calls *space*; it is a twisted space of five or six dimensions, and correspondingly hard to work with; but it is a single thing, not four individualities; and it can be worked with, if you are a mathematician enough. In addition, Einstein showed the existence of new interrelations between matter, light, and electricity; and experiment seems to bear him out. Light "travels" in a straight

line in the Einstein space; consequently it bends around the sun in ours. Dynamics, which is the study of matter in motion, becomes simply geometry of five or six dimensions; and mass and time, as well as distance, are measured in miles. The existence of time and space is bound up with the existence of matter, Einstein asserts.

The word *relativity*, as used by Einstein, means that there is no possibility of measuring absolute time, distance, or mass. Two observers studying the same phenomenon will not arrive at the same numerical results, if one is moving with respect to the other. Consequently the terms "absolute time," "absolute mass," and "absolute distance" have no meaning in physics; time and mass and distance exist only in relation to the observer. A similar doctrine has long been advocated in pure philosophy, but Einstein was the first to give the principle of relativity quantitative expression and the possibility of physical proof.

Albert Einstein published his first paper on relativity in 1905, in "Annalen der Physik." At that time he was employed in the Swiss patent office; at present he holds a professorship in Berlin. Since 1905 he has published numerous other papers; and, beginning about 1910, he extended his original principle of relativity, which applied to distance and time only, to include mass also. Mass, or inertia, is perhaps the most fundamental property of matter, and is closely bound up with gravitation. There have been altogether three stages in the development of Einstein's "general principle of relativity." During many years prior to 1905 the groundwork was laid by other investigators, many of whom were interested in the formulation of an electromagnetic theory of matter. The first Einstein relativity theory, as stated above, dates from 1905; and the generalized theory was fully formulated in 1916.

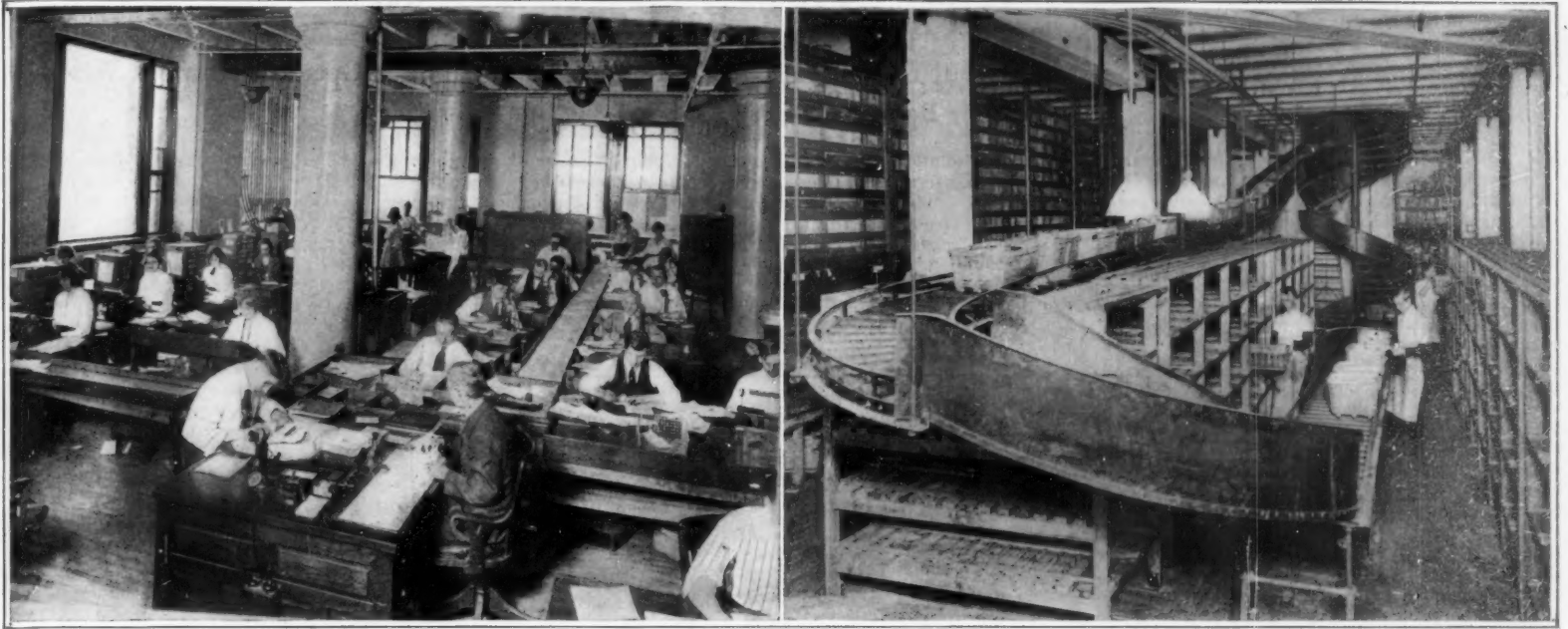
The "How" of Einstein's Theory

Some time after the publication of Einstein's original relativity theory of time and space, it was pointed out by Minkowski that what Einstein had really done was to treat time as the fourth dimension. Length, breadth, and height are the three dimensions of ordinary "Euclidean" space, which is treated in the school geometries, and assumed in everyday life. The human mind can also conceive of space having only two dimensions, as witness our "plane geometry"; or of one dimension, the straight line; but we find it impossible to think of space of four dimensions. In the equations of mathematical physics, however, the variable *t*, representing time, enters on the same footing as the variables *x*, *y*, and *z*, the space coordinates; and this leads to a mathematical conception of time as the fourth dimension.

The motion-picture offers a certain analogy. The picture projected on the flat screen possesses, of course, only two dimensions; we interpret it, however, in three, as we interpret any photograph. This is not the matter in point here. The important thing is that the objects in the motion-picture appear to move. Everybody knows the explanation: what we are looking at is not a single picture containing moving objects, but a succession of pictures, each with fixed objects; the substitution of a new picture for the preceding one takes place so rapidly that we are unconscious of it. When we look at an ordinary photograph we receive the impression of space, but not of time; when we watch a "movie" we perceive time as well as space. This impression of time is due to the motion of the reel of film inside the projecting lantern, a motion which has no counterpart on the screen, and of which the observer is not conscious. So far as he is concerned the motion of the film in the lantern is in another dimension, the time dimension.

The purely speculative suggestion was made long ago that the sensation of time experienced in ordinary life was due to unperceived motion in an assumed fourth dimension. An infinite number of worlds might be supposed to exist, nearly alike; but with slight differences which we interpret as motions of objects, when our consciousness is transported unaware from one world to the next in the succession. At any given

(Continued on page 27)



Two conveyor installations of unusual interest

Left: Distributing office work from station to station via conveyor. Right: Spiral and curved conveyors raised to the nth power save much labor in this stockroom, and increase the value of mezzanine storage space

Putting Gravity to Work in Office and Shop

THE conveyor belt, whether it operates by gravity or by impressed power, is so well established and so thoroughly familiar to most of us that any further discussion of its general merits would be as superfluous as a similar argument in favor of the automobile or the typewriter. There still remains, however, in this field as in all others, the opportunity from time to time to show interesting new installations and point out specific uses to which the conveyor has not generally been put, and specific advantages of its employment which may not have been generally noted.

The pictures herewith show two especially interesting types of gravity conveyor. The one brings out very clearly one point with which some of us are doubtless not yet on terms of complete familiarity—the ease with which the conveyor can negotiate turns of any degree of complexity. This not alone makes it possible to turn a corner, but gives us the spiral conveyor, which comes down from a great height in the same space occupied by an elevator or a stairway. The photograph shows such a spiral in the background, descending from the upper stories of the building; while in the foreground we have an excellent illustration of the ability of the conveyor, by appropriate turns, to double on itself and to deliver its load in any desired position or direction.

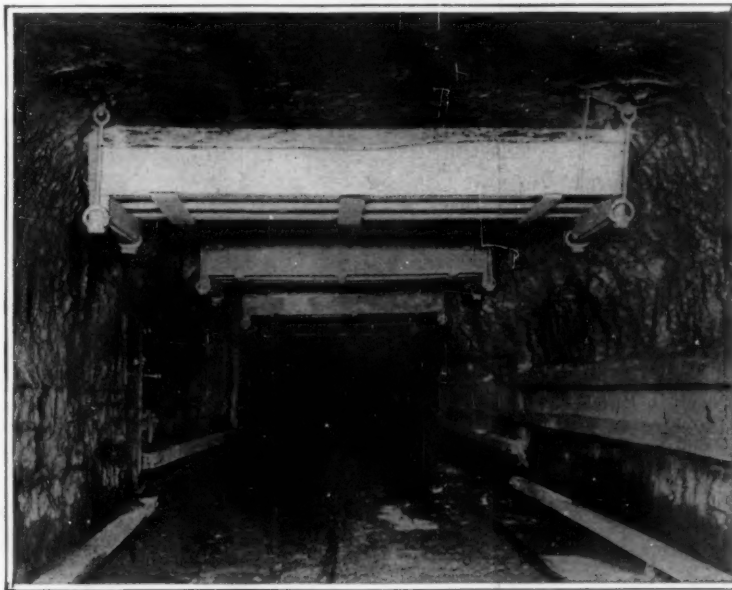
The other photograph makes it clear that in addition to its accepted field in factory and warehouse, the conveyor may be of considerable utility in the office. In the picture shown the belt travels with sufficient slowness so that the clerks whose stations it passes are able to select from the documents which it carries such as demand their attention; and in this way a very complicated office routine can be carried out without the nuisance of messengers continually distracting the attention and getting in the way, and without the loss of time involved when the clerks themselves have to get work to be done or deliver their finished product to the next man.

A Curtain of Dust to Check a Fire

WE extinguish a fire by diluting the combustible material, whatever it may be, with enough non-combustible—ordinarily water—to render the mixture impervious to flame, or at least reluctant to burn. If we wish to arrest an explosion, we may fall back upon the same idea; only the explosion travels so fast that the problem of mixing the explosive vapors with enough inert material, and bringing about this mixture

fast enough, is a difficult one. Our photograph shows how it has been solved in some of our coal mines.

It has for some time been recognized, as the result of experiments originally initiated by the Bureau of Mines, that ordinary rock dust, when mixed with coal dust, makes the latter much less liable to explode. The principle, of course, is simply that suggested above. Various means have been brought forward for effecting the combination, some of them contemplating that the entire coal-dust-laden atmosphere of the mine be diluted with the inert rock dust, while others attempt only to introduce the rock dust at the time and place of danger. The device illustrated in the photograph just below is of the latter type.



These boxes contain stone dust which is released to hamper the spread of mine explosions

Along the roof of the heading is placed a series of long boxes, filled with rock dust of an inert character. These boxes are suspended in such a way that they are not a menace to ordinary traffic, and yet so delicately that a very moderate shock from a nearby explosion will jar them loose from their moorings. Their content of finely divided rock dust is then precipitated into the atmosphere of the heading, and when the wave of the explosion arrives at this part of the passage, the carbon dust to feed it is present in insufficient concentration and the fire dies out before it can penetrate the curtain of stone that has been dropped in front of it. Test has shown this a very efficient means of combatting mine explosions.

The Strength of Bolts and Nuts

THE chief engineer of a large British association draws attention to the fact that very slight irregularities in the shapes of screw threads, and more particularly in the relative pitches of screwed bolts and nuts, may produce very serious local stresses at the roots of the threads, stresses which are found to be far more intense than the over-all tension stresses in the core of the bolt. It is also known that the finer the threads the more intense the local stresses, and that, contrary to the generally accepted view, a bolt with a fine thread and, therefore, with a relatively large core is no stronger than a bolt with a coarse thread. The local stresses can be greatly intensified by making the pitch of the nut finer than that of the bolt, and this malpractice is not an uncommon one. Most bolts have their threads cut with dies, and when these get blunt they tend to lengthen the bolts while they are cutting and compressing them. Then also large bolts and nuts are turned in lathes, and when these have seen much service, the leading screw exhibits more severe wear near the headstock where the nut would be turned than further off where the bolt thread would be turned. The result seems to be that many large nuts have firmer threads than their bolts. The consequence is that when the bolts are loaded, it is only the threads near the lower end of the nuts which carry the load. The resulting local stresses combining with the longitudinal pull, which is also a maximum at this level, are very severe—so intense indeed that no simpler means for breaking off a bolt end could be devised than using a hard steel nut with a relatively fine thread and wrenching off the bolt end.

Conversely if the nut is the coarser, a very marked reduction in the stresses near the lower level of the nut can be effected by making the nut thread of a slightly coarser pitch, say one-tenth per cent, than that of the bolt. When the nut is screwed on and a pull applied, the bolt will at first rest only on the upper threads of the nut, and gradually, as the load is increased, the bolt lengthens and more and more threads become engaged until all the threads are offering a fair share of resistance. It is of course no easy matter to produce absolutely correct pitches, but seeing that irregularities do occur, and that relatively fine threads in the nuts are dangerous, it would be an advantage to aim at not allowing the bolt thread pitch to exceed a certain limit, and also not allowing the nut thread pitch to fall below this limit. Comparatively little notice is taken of these matters, and failures are attributed to bad material or carelessness on the part of the workmen.

The All-Year Car

Suggestions for the Average Motorist That Will Help in Securing Economical and Safe Car Operation in Cold Weather

By Victor W. Pagé, M.S.A.E.

WHEN the automobile first began to attract general attention as a practical means of transportation and before the advent of the modern closed body in its popular coupe and sedan forms, it was not considered an all-year-round vehicle except in localities favored with mild winters. The old idea was to "lay the car up" for the winter, because the open-body touring or roadster model of the early days was far from comfortable in cold weather. Today all is changed; the automobile is recognized as a method of transportation that can be used when the weather is inclement as well as when the sun is shining.

The modern open car has been greatly improved in body design. The new straight-side forms are particularly well adapted to a thorough enclosure that was almost impossible in the days when a designer's ambition was to see how many curves he could work into the body. Better fitting tops and wind shields are supplied as standard equipment on even the most inexpensive cars and side curtains are now considered an integral part of the car and fit in with the design instead of being an afterthought. The result is that a body can be thoroughly enclosed with well fitting curtains and the cold air kept out so that even if the motorist owns nothing but an open car, he need not discontinue its use during the winter if he will take the few precautionary measures which are necessary to keep the car in good condition and to insure comfort of the occupants.

Power Plant Auxiliaries Need Attention

The first point to be considered is the power plant auxiliaries, as cold weather brings with it problems in cooling, carburetion and lubrication. The cooling system not only must be provided with a liquid that will not freeze but should also be equipped with devices that will prevent "overcooling." It is evident that a radiating system that will be adequate for hot weather service will be more than efficient during cool weather. The cooling water passes through radiator tubes of small cross sectional area for a water passage and large radiating surface area for air to pass over. The tubes of a modern cellular or honeycomb radiator are made of thin metal and if the water freezes in them, they will open up at the seams. It does not suffice to lower the freezing point of the water by putting various salts, oils or other liquids in combination with it because this merely reduces the liability of freezing and does not take care of the possibility of overcooling. Especially at this time, when fuel is of lower volatility than usual, one must take care that the engine attains its proper operating temperature.

The anti-freezing solutions that have been offered are legion, the best known being calcium chloride and water; glycerine, alcohol and water; and alcohol and water. There are also a number of prepared solutions which can be used with satisfaction but the writer has always obtained good results with plain alcohol and

water solutions. They are simple in composition and have no injurious effect on the engine parts. Being entirely fluid, there are no salts to crystallize out; and if care is taken to keep the solution at the proper specific gravity by compensating for the evaporation through the overflow pipe, no trouble will be experienced from the water's congealing. A solution containing 30 per cent of alcohol will not freeze at temperatures above five degrees below zero, Fahrenheit; and

ing, steps should be taken to conserve the heat of the motor. While the usual method of throwing a blanket or robe over the radiator when the car is stopped does keep the heat in, this is but a makeshift and on a windy day it is extremely difficult to hold the covering in place. A well fitting, padded leather or fabric hood or one that is felt-lined is a good investment and is neat and efficient. These covers are provided with curtains that may be rolled up to expose any desired area of

the radiator to the cooling effect of the air and one make is sold provided with adjustable shutters at the front to serve the same purpose. These covers may be obtained to fit the standard makes of cars and when properly installed they will stay in place under all conditions.

Motor Should Be Kept Warm

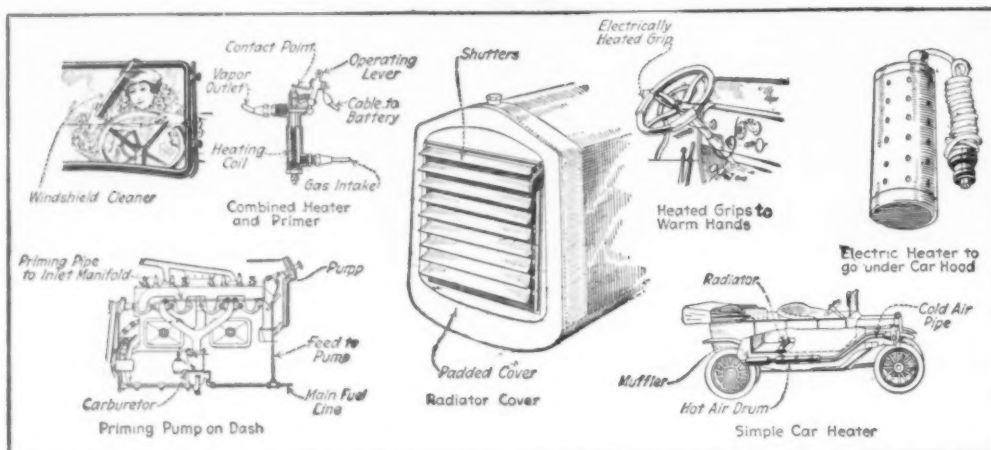
There are two good reasons why a motor should be kept warm, one is the difficulty of properly vaporizing the liquid globules of the fuel mixture if the motor is running cold, the other is the necessity of keeping the oil fluid so it will flow readily. If a car is kept in a heated garage, no trouble will be experienced in starting, but if it is not stored in a warm place, then the motorist can expect difficult starting. A cold motor is hard to turn over because of the stiffness caused by the friction of congealed oil in the cylinders and bearings and considerable extra load is imposed on the starting battery. Coupled with the fact that the mixture in a cold motor will not ignite easily and that a storage battery is about 50 per cent efficient in freezing weather, it is not hard to understand why every precaution should be taken to retain

the motor heat or provide auxiliary devices that will make starting easier. When the radiator is not covered, some motorists make a practice of loosening the fan drive belt or removing it altogether to reduce the cooling effect in cold weather. The front of the radiator is sometimes partially screened by a cardboard or a sheet metal piece held against the radiator by wires but neither of these methods can be recommended when radiator covers are so inexpensive and efficient and always in place when wanted.

Priming Devices Promote Easy Starting

To make starting easier, various priming devices are offered. While it is not difficult to prime any motor provided with compression relief cocks with an ordinary hand oil can or squirt gun filled with a half-and-half mixture of ether and gasoline, this involves raising

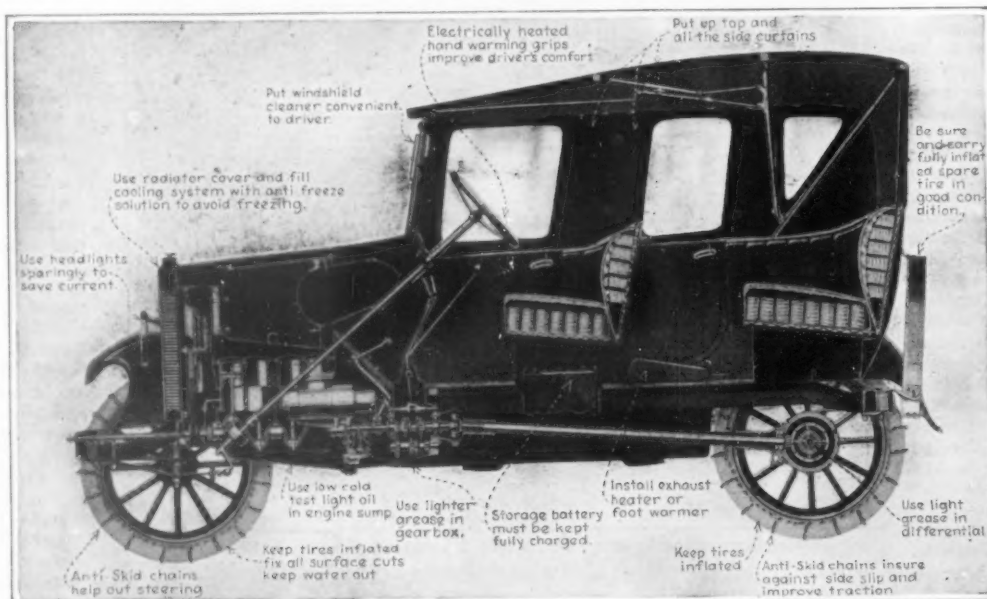
the hood and is a "mussy" job at the best. Primers of various types are easily fitted, these ranging from a simple pump that draws gasoline from the main fuel supply line and sprays it into the manifold near the inlet valve ports to more complicated electrically heated primers that not only deliver a spray of liquid to the manifold but heat it before delivery to promote easier vaporization. Small containers provided with a shut-off cock and a short length of tubing to reach



Some of the appliances that make automobiling in winter easy, safe and convenient

a 35 per cent solution will remain fluid down to 15 degrees below zero. It will be evident that either of these solutions will take care of normal drops in temperature unless the car must be left out for periods of several hours in severe climates. Stronger solutions will have still lower freezing points as the appended table shows.

If it is desired to use an alcohol solution, the following are the proportions of water and alcohol that should be used. The solutions will evaporate, therefore



A part sectional view of a modern passenger car equipped with accessories for safe and effective winter driving

alcohol should be added from time to time, and readings taken, if possible by hydrometer syringe.

Denatured Alcohol (Per Cent by Volume)	Water (Per Cent by Volume)	Freezing Temperatures (Deg. Fahr.)	Specific Gravity (Hydrometer Reading)
20	80	Above zero 13°	.974
30	70	Below zero 3°	.964
40	60	Below zero 20°	.953
50	50	Below zero 34°	.936

After taking reasonable precautions against freez-

(Continued on page 27)



The South American ovenbird and its ten-pound clay nest

The Original Clay Workers

THIS is the South American ovenbird, a builder who is entitled to honorable mention among the notable clay-workers of the world. He is of the creeper family, small and brown, with slender beak and wings so short he cannot fly very well.

Every spring, the father and mother bird together build a brand new house with clay, mixed with a little hair or grass or feathers, well plastered together and completely domed over, and as the clay dries in the sun the walls become quite firm. They sometimes take several months in building the nest, depending upon proper rainfall to make the mud of the right consistency for their purpose.

The finished nest weighs from nine to ten pounds, is ten inches high, about nine inches in breadth and six inches deep. The entrance is narrow and winding, reminding one of a conch shell, and the interior is divided into two rooms, in the farther one of which the eggs are laid.

The ovenbird likes to build its nest near human habitations, and will locate on top of a window, in a tree or on a telegraph pole, or even on the ridge-pole of a house. The one shown in the picture was built in the branches of an old apple tree, in the kitchen garden, where the birds could be sure of a plentiful supply of seeds and insects.

In Brazil, where the people talk Portuguese, the ovenbird is called *furnarius*, or furnace bird, and in Argentina he is called in the Spanish language, *el hornero*, or the baker.—G. E. McDonald.

A Flying Boat Service from Key West to Havana

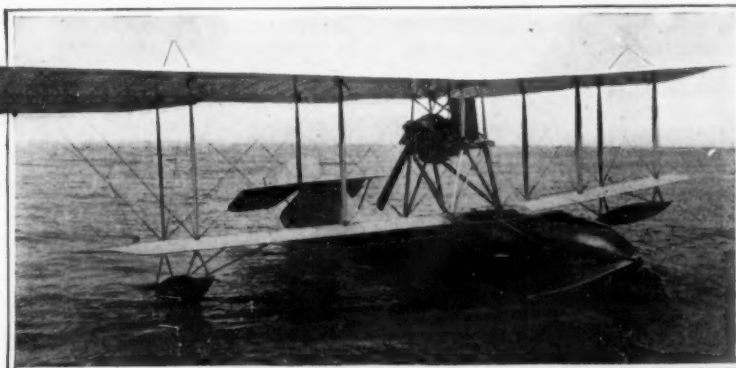
IN view of the failure of our Government to make adequate provision for conserving the fruits of the war in the field of aeronautics, it is gratifying to know that civilian enterprise is taking hold here and there. Commercial flying is going ahead by leaps and bounds on the other side of the water, and notably between the British Isles and the Continent. In European countries, however, such efforts have behind them the encouragement of the respective governments to an extent that we know nothing of here. Hence, such work as is being done by private firms is the more commendable and should receive every encouragement from the press and public of the United States. We take much pleasure in presenting in this issue a photograph of one of a group of passenger seaplanes which have been built to establish a regular passenger service between Key West and Havana. At present, there are two boats of the type known as model 50-B in the service, and others are under construction. This seaplane, which was built by the Aero-marine Company, has an upper wing spread of 48 feet 4 inches and a lower wing spread of 37 feet 4 inches, the two planes being staggered to the extent of 8 inches. The chord is 75 inches and the gap, 78 inches, and there is a dihedral angle of 2 degrees. The total wing area is 504 square feet, including the ailerons. The length over all is 28 feet 11 inches. In a light condition, the weight is 1,925

pounds, and in a loaded condition, with 35 gallons of gasoline aboard, the weight is 2,485 pounds. The seating arrangement provides for one operator and one passenger in the 40-T model, and in the 50-T model, there is provision for three persons, two passengers seated side by side, and a pilot seated in a separate cockpit forward of the passengers. Model 50-T is the one which is being used in the service to Cuba, and the passenger space is enclosed or open, with a movable windshield. With a motor of 125 to 130 horsepower, the speed is 80 miles per hour, the landing speed, 38 miles per hour, and the climb is 2,500 feet in ten minutes. The bottoms of the hulls are constructed of two-ply wood, placed diagonally with cloth between and clinched with brass fastenings. The sides and decks are of three-ply waterproof veneer.

House Heating With Gas in Place of Coal

EARLY in October when the need for artificial heat first makes itself felt, the owner of a large private dwelling in the exclusive west side section of New York City goes into the sub-basement of his house and lights one match. The flame of this match is applied to the pilot of a gas boiler; and from that moment on, all winter long, regardless of how cold or how warm it may be outside, without any attention at all, the big seventeen-room house is automatically kept at an even temperature of 70 degrees F. by day and 50 degrees F. at night. In May when there is no longer any need for artificial heat the pilot on the boiler is extinguished.

This summarizes briefly about all the care that need be given to a well designed and properly installed gas house heating system. With it there need be no bother about coal, no waiting for steam to be generated, no dependence on helpers or furnace men or no inconvenience of ash removal. Gas is instantly available and aside from its convenience and cleanliness, it has been found that at present prices for coal, gas is very slightly cheaper.

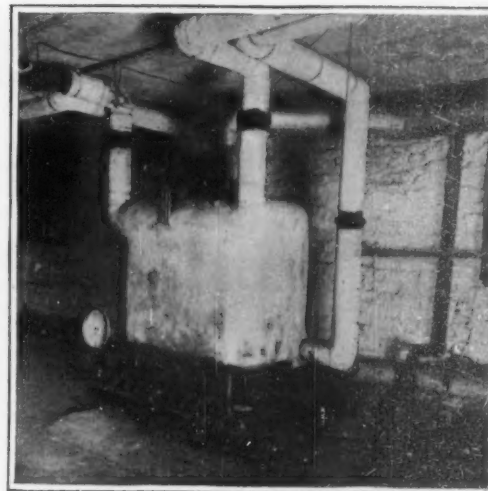


This seaplane is in regular service between Key West and Havana

This house, which is occupied by the president of a large bank, is completely heated by gas. The owner was willing to pay 150 per cent more for gas than for coal in order to obtain its advantages; but a careful check on costs has shown them slightly less than with coal.

Up to the time that the gas heating system was installed the house had been heated by a warm air furnace. An additional story was added to the three-story house, making a total of four stories. It is a brick house and is exposed in the front and rear. The total number of rooms to be heated, including the additional story and some rooms in the rear which previously had not been heated, is seventeen.

In accordance with good gas-heating engineering practice an eight-section return tubular boiler was in-



This gas boiler heats a whole house without attention

stalled in the basement. This boiler is directly connected through a large gas meter with the mains of the gas company; and artificial city gas is the only fuel used. Hot water radiators were installed throughout the house in accordance with standard heating engineering practice; and a total of 777 square feet of radiation was necessary. About one-quarter of this was used in the additional story.

Two heat regulators were installed to insure positive automatic regulation. One was placed in the living room and the other at the hot water outlet of the gas boiler. The temperature is so regulated that 70 degrees Fahrenheit is maintained during the day and 50 or 55 degrees, as desired, at night. When the regulator is set it controls the temperature throughout the entire building and automatically, by reason of the clock arrangement, makes the shift from the day-time temperature to the night-time temperature at ten o'clock at night. The regulator, it might be added, is adjustable and can be set to keep the hot water at any desired temperature. Thus, at the beginning of the heating season it has been found that a water temperature of 120 degrees is adequate. This is automatically increased to 180 degrees during the coldest days of the winter. Automatically it is also reduced when the outside temperature rises. Thus the water is carried at a temperature proportional to the outside temperature, which is the most satisfactory way of supplying the heat losses from the rooms. This control has much to do with the cheap and efficient operation of the system.

Bearing in mind that an additional story was added at the time of the installation of the gas heating system, and making a fair allowance for this, some interesting comparative figures have been secured as to the cost of operation of the gas heating system with its predecessor, the warm air coal heating system.

Thus, in the year 1916-1917, a typical year, the coal furnace consumed 15 tons of coal. The cost of the furnace attendance for seven months at \$5 per month was \$35; and the kindling wood used totalled a quarter of a cord. Coal in New York today costs \$9 per ton and kindling wood \$22 per cord. Assuming that the cost of labor has doubled, the total cost of operating the coal system at present prices would be:

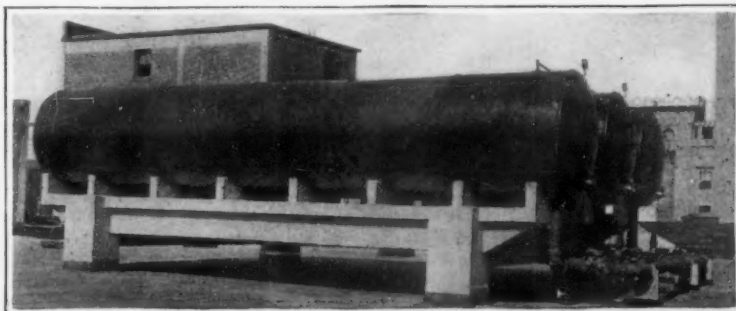
15 tons of coal, cost \$9 per ton.....	\$135.00
Attendance of furnace, 7 months at \$10	70.00
Kindling wood, ¼ cord at \$22.....	5.50

Total cost of coal heating system at present prices for coal, wood and labor

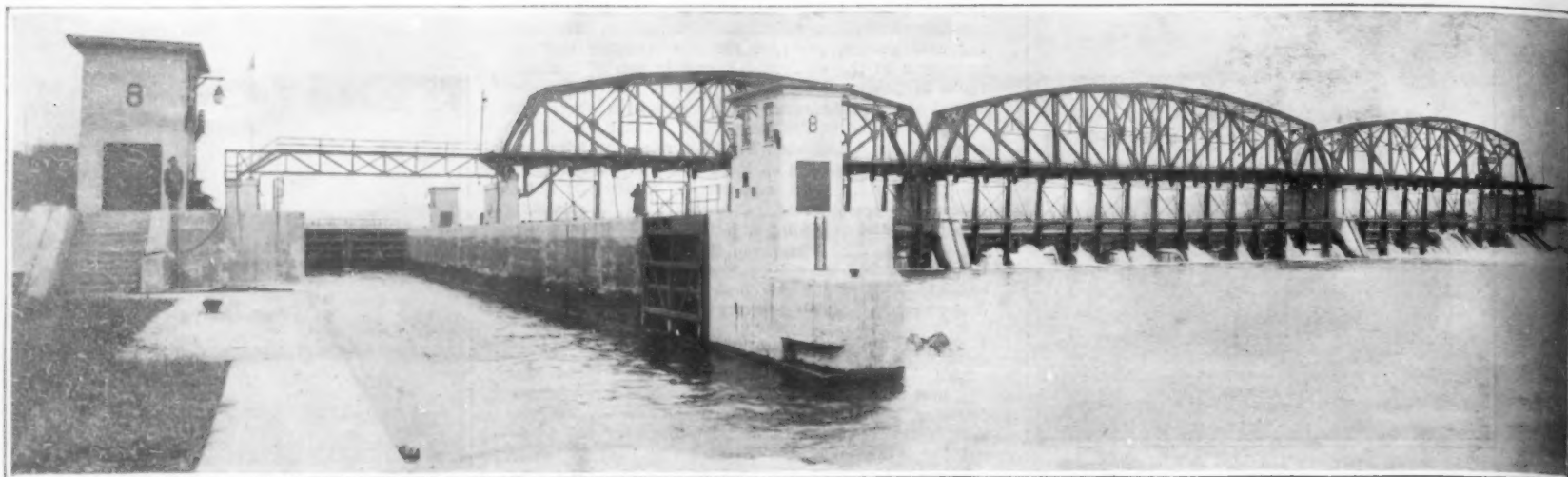
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Water Tanks Supported on Concrete Foundations

THREE water tanks recently installed on the roof of a new building in Los Angeles are supported on concrete foundations. Each tank rests directly on eight concrete saddles, which in turn are supported by four concrete columns. The entire installation presents an unusually compact and neat appearance, as shown in the accompanying illustration. —C. W. Geiger.



These supports for water tanks are but another proof of the versatility of concrete



Movable dam and lock in Mohawk River Canalization, Erie Branch, State Barge Canal

The New York State Barge Canal—I

World's Greatest Inland Canal Now Connects the Great Lakes with the Atlantic Ocean

By Frank M. Williams, State Engineer and Surveyor of New York

VERY few people in the United States or the State of New York, itself, have any real conception of the magnitude of the new Barge Canal which that state has constructed between the Great Lakes and Atlantic Seaboard. Those who have seen in the past few years the old channels which the modern waterway has replaced, picture the new route as a narrow, shallow channel retained by embankments and containing dirty, sluggish water upon which ride old canal boats towed by mules or, on occasion, by small tugboats. Nothing could be further from the truth, for the new waterway is, for the greater part of its length, a canalization of existing rivers and lakes, and contains numerous engineering features. In fact, it rivals, as a constructive work, any canal in the world. Furthermore, one will find no mules towing canal boats but will see modern steel and concrete barges moving along the wide channels usually in fleets of four, the whole carrying from 1,000 to 2,500 tons of freight. Instead of antiquated locks whose gates are opened and closed by hand one will find massive concrete structures with heavy steel gates, which are operated by electricity, the operator merely turning a switch which is located in a steel cabinet on one of the concrete side walls.

Natural Conditions Favorable

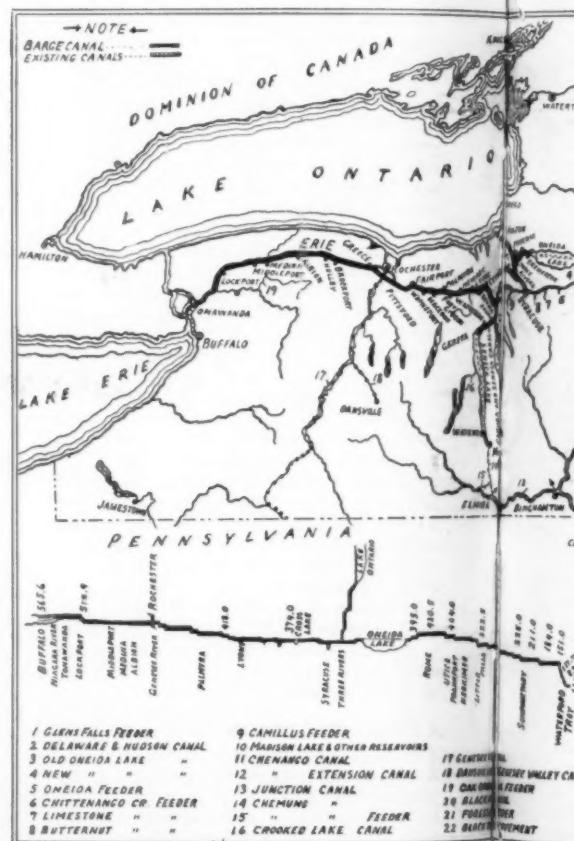
This great canal system has been constructed in New York because the natural conditions were more favorable in that state than anywhere else for the opening of water communication between the Great Lakes and the Atlantic Ocean. This is due to the fact that the ranges of mountains lying between the Great Lakes and the Atlantic Seaboard practically disappear as they approach the Mohawk Valley from the west. Furthermore, it was this comparatively low level route passing up the Mohawk River to the head of the waters of Wood Creek into Oneida Lake; down that body of water to the Oneida and

Seneca Rivers at the head of Oswego River; thence either by the Oswego River to Lake Ontario or ascending the Seneca River and its branches to the interior lakes, which was used by the Indians and early settlers as a natural and easy route for communication between the east and the west. This time-honored usage led to the early examination of this route when the project for better means of transportation was first considered, and about 1791 the first attempts were made to improve it by the construction of locks by private companies under charter by the state.

The Erie Canal Is Built

These early attempts led to the actual construction of the Erie Canal, which began July 4, 1817, and was completed October 26, 1825. This was shortly followed by the construction of the Champlain and Oswego and other canals. After the Erie Canal had been in use for a few years, it became evident that the benefits to be derived would be greatly increased if it were made larger, and this led to the first enlargement extending over the period of 1836 to 1862 which was followed by two partial enlargements during the period up to 1898.

In 1899, the late Col. Theodore Roosevelt, then Governor of the State of New York, appointed a Canal Commission to investigate and report whether the canals should be improved to barge canal dimensions and retained; whether they should be enlarged or actually abandoned. The committee, early in 1900, reported in favor of the retention of the canals, recommending that the Erie Canal be enlarged to provide for boats of 1,000 tons burden, and that the Oswego and Champlain canals should be improved so as to accommodate boats of a smaller capacity. This same year, the Legislature appropriated \$200,000 for making surveys, plans and estimates and a report of the probable cost of what became known as the Barge Canal.



Maps and profiles of New State B



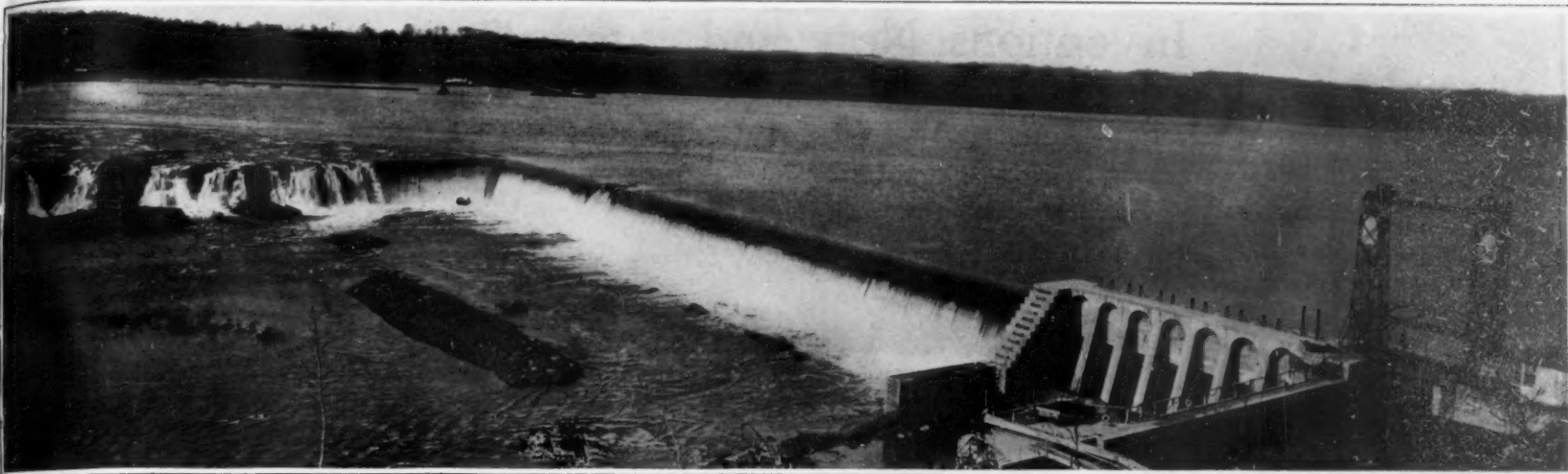
Line of big Taintor Gates, movable dam, Champlain Branch



First Canal Lock built in United States, at Little Falls



Tow of old canal boats through Canal lock



Barge Canal Dam at Vischer's Ferry, Mohawk River Canalization

As a result the State Engineer submitted a report giving estimates, on February 12, 1901, and, in 1903, the Legislature provided for the submission to the people at the general election in that year of the project for the improvement of the Erie, Champlain and Oswego canals to a uniform depth of 12 feet and a width which should be 75 feet at the bottom of earth sections of the "land line" 94 feet in rock cuts and 200 feet in the beds of the canalized rivers and lakes. This referendum which also provided for the sale of bonds to the amount of \$101,000,000 for the construction of the canal system was approved by a substantial majority and the first actual construction work on the Barge Canal started at Fort Miller on the Champlain branch April 24, 1905. Shortly afterward an important change was made in the original plans and provision was made to widen the lock chambers from 28 to 45 feet. This change practically doubled the capacity of the locks and made the canal a 3,000-ton instead of a 1,000-ton waterway.

In 1909, a further change was made in the canal system and the people, by approving of an additional bond issue to the amount of \$7,000,000 added the present Cayuga-Seneca branch to the Barge Canal.

Route of the Barge Canal

The Erie branch of the modern waterway leaves the Hudson River at Waterford, utilizes the Mohawk River westward to the vicinity of Utica, passes over a divide into Oneida Lake and through that body of water to the Oneida River and down that stream to Three River Point, the junction of the Oneida and Seneca Rivers. From here it ascends the Seneca River and its branches to Lyons and runs thence to the Genesee River at Rochester. After crossing the Genesee River at this city in a pool formed by a dam, the channel westward to the Niagara River, at Tonawanda, is virtually an enlargement of the old Erie Canal and Tonawanda Creek. From Tonawanda to Buffalo and Lake Erie the channel follows the Niagara River.

The Oswego Canal starts at the junction of the Oneida and Seneca and Oswego Rivers at Three River Point and passes northward down the Oswego River to Lake Ontario.

The Champlain branch running northward along the

easterly boundary of the state starts at Waterford on the Hudson River, follows that stream to Fort Edward, passes over a divide to Fort Ann and then follows the bed of the canalized Wood Creek to Whitehall on Lake Champlain.

The Cayuga-Seneca canal leaves the Erie branch near Montezuma and ascends the Seneca River to Seneca Lake with a branch to Cayuga Lake, thus connecting the two lakes with the Barge Canal.

The Erie and Champlain canals reach the Atlantic seaboard at New York City by means of the tidal Hudson River after passing through the Federal lock constructed at Troy.

Elevation

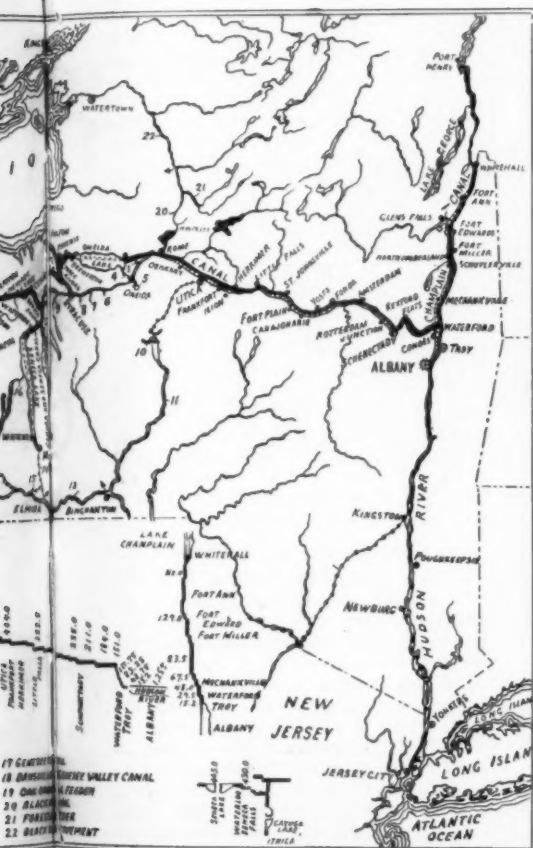
Starting with an elevation of 15.2 feet above tide water at Waterford, the Barge Canal gradually ascends to an elevation of 420 feet at Rome; then descends westward to an elevation of 363 feet above sea level at Three River Point and gradually rises to an elevation of 565.6 feet at the Niagara River at Tonawanda.

The Oswego branch descends northward from Three River Point to an elevation of 244.4 feet at Lake Ontario. From Waterford the Champlain Canal ascends to an elevation of 140 feet at Fort Edward and descends to an elevation of 96.5 feet at Lake Champlain.

Method of Construction

The new waterway has been constructed in accordance with principles radically differing from those governing on the original Erie Canal. This old channel was constructed on the hillside, above the rivers and streams, and was designed so that animal power could be used for towing purposes and this same plan was used on the canals following the Erie's construction. The Barge Canal, however, so far as feasible follows the natural streams, thus lessening the cost of construction and the loss of water by percolation and seepage and is designed so that barges must be towed or propelled by mechanical means, no towpath being provided.

(To be continued in following issue)



Map of New York State Barge Canal



Interior of Barge Canal lock chamber



Interior of Barge Canal Pier Shed, New York



New Barge Canal Terminal, Pier 6, East River

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

An Automatic Stereopticon

THE automatic stereopticon represents a new use of electricity, and is a simple device that can be carried in a suitcase, costs little to operate, has nothing to wear out or replace, and will last practically a lifetime.

Its essential parts are a 1,000 candle-power, nitrogen tungsten projection lamp, condensing and objective lenses, a screen upon which the pictures are to be projected, the necessary slides, and small electric motor to be attached to an electric light socket, and which operates by either direct or alternating current.

The usual size projects forty-six slides upon the screen, allowing each to remain in position twelve seconds, when it is automatically replaced by the next. Machines which project one hundred, two hundred or more slides, may be built to order.

The picture may be shown either large or small by merely varying the distance of the objective lens from the screen. The projection is in the form of a cone with the small end at the lens, and the large end on the screen, and the farther the screen from the machine, the larger the picture.

This automatic stereopticon is invaluable for store and window advertising, for educational work, home entertainments, and for a hundred purposes that will suggest themselves. Attractive and interesting, tireless and reliable, it is said to be a valuable sales force for all commodities.

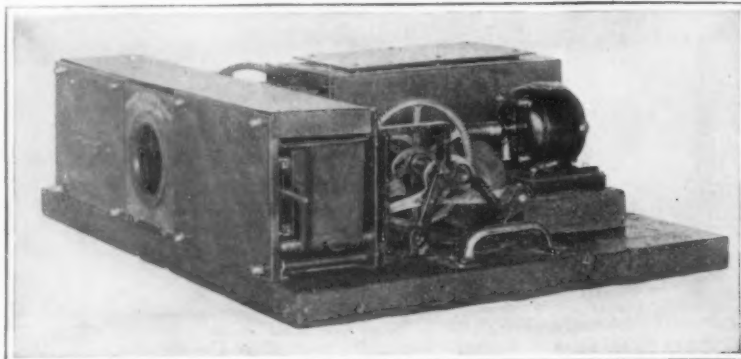
Piano and Phonograph—A Musical Partnership

A NEW twist has been given to the player piano by incorporating a phonograph in its cabinet, as shown in the accompanying illustration. The phonograph, it will be noted, is the conventional form of instrument, with its individual spring motor. This interesting musical partnership permits of enjoying either the piano music or phonograph, or again, both of them at one time. By carefully regulating the speed of the player piano and that of the phonograph, the two instruments can be made to play together in perfect harmony and tempo. The player piano, of course, maintains the same pitch irrespective of speed, while the phonograph's pitch varies with the speed. Hence it is usually necessary to vary the phonograph until the pitch corresponds with that of the piano, and then adjust the speed of the player piano until it is in synchronism with the phonograph. At any rate, we are assured that the musical results are well worth the slight trouble involved.

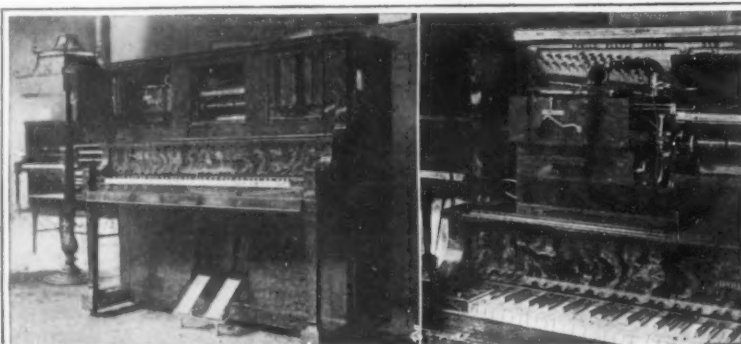
And Now the Anti-Insonnia Bed

A MATTRESS which is said to be positively conducive to sound sleep, has been invented by Miss Alice O. Darling of Tilton, N. H. The mattress, which is shown in the accompanying illustration, is in three sections: the main long section supports the body, the two upper sections, which are attached to each other by hinge-like members, providing a raised support for the forehead of a person lying face downwards.

According to this lady inventor, the prone position relieves blood pressure from the vital organs and from the brain. It has been found that this position eliminates the persistent distressing and sometimes injurious coughing in diseases of the stomach. The posture which the



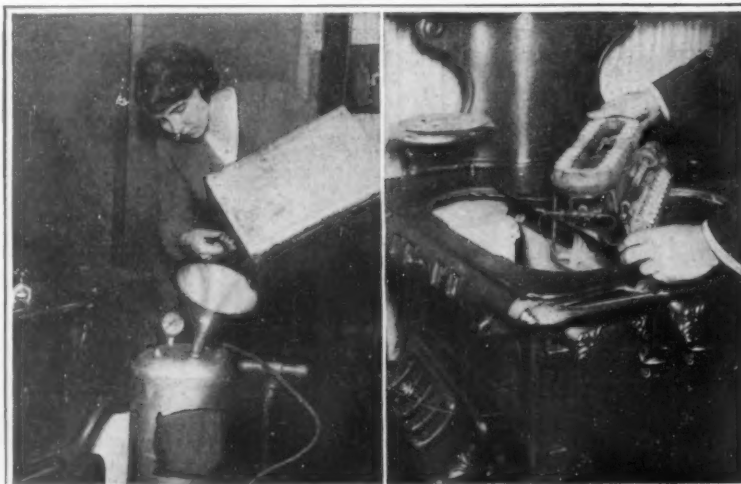
This machine automatically projects 46 slides on the screen



An ingenious combination of phonograph and player piano for music lovers



This mattress enables a person to lie prone, thereby aiding sleep and general comfort



The pressure tank and the burner used in firing a coal range with gasoline

patient assumes on this mattress relieves from pressure that part of the brain known as the *medulla oblongata*, situated at the base and back of the head, thereby permitting the person to fall asleep in a short time.

During the day time the two upper sections of the mattress may be folded into alignment so as to permit the bed to be made up to present the same appearance as the ordinary bed.

Gasoline Instead of Coal for the Coal Range

ONE of the results of the present coal shortage has been to direct attention to the various ways of heating and cooking without coal. More and more attention has been paid to oil as a fuel, with the result that several ingenious oil-burning systems are now available.

For converting any coal range into a gasoline range, there has been introduced the simple system shown in the two accompanying illustrations. The fuel is placed in a pressure tank which may be located in any suitable part of the house, with a small copper pipe leading to the burner in the stove. Pressure is applied to the fuel tank by means of a hand pump, a gage indicating the pressure at all times. The burner has a large number of jets and gives a hot, blue flame, similar to that obtained with a Bunsen burner or with a powerful blow-torch. The heat can be regulated at will.

The numerous advantages of the gasoline system of firing a coal range are too obvious to require elaboration here. Suffice it to say that this system is absolutely clean—there are no ashes to deal with; it is convenient—striking a match is all the work involved in starting the fire; and it is economical—the fuel is used only when it is needed.

Latest Patent Decisions

Unpatented Anticipations.—This is a suit in equity based on the alleged infringement of a patent for a screw driver. The patented screw driver consists of an integral solid drop-forging, beginning at the top with an oval butt having a flat hammer face, and continuing into a flat handle web, into which scales of an elliptical shape gradually decreasing in width are riveted, continuing into a conical tapering bolster, continuing into a round shaft, ending up in the flat blade.

As to the unpatented devices which are claimed to be anticipation of the patent in suit, it is alleged that certain employees of the plaintiff made certain screw drivers for their personal use. Many other screw drivers were put in evidence as anticipation. None of them resemble, except in some slight degree, the Ward screw driver.

The design in suit is pleasing to the eye, and novel. The defendant's screw driver, however, is such a close copy of it, that the ordinary purchaser, when handed the defendant's driver, would conclude he was purchasing the plaintiff's driver, if he could not see them side by side. The variations are so slight as not to avoid infringement, and there must be a decree for the plaintiff.

The point of law herein is this: when an unpatented device, the existence and use of which are proven only by oral testimony, is set up as a complete anticipation of a patent, the proof sustaining it must be clear, satisfactory, and beyond a reasonable doubt.—*H. D. Smith & Co. v. Peck, Stow & Wilcox Co.* U. S. D. C. of Conn.



Copyright 1920, by The Goodyear Tire & Rubber Co., Akron, O.

"PNEUMATICS offer all-round advantages over solid tires in our hauling—save trucks, loads, and improve working spirit of drivers. They require $1\frac{1}{2}$ less gallons of gasoline on a 90-mile run. Solid-tired trucks sway over the road, but trucks on pneumatics run straight. Goodyear Cords are giving excellent service."— P. P. Triller, Purchasing Agent, The Wadley Company, Produce Wholesalers, Indianapolis, Indiana

DURING the past year Goodyear Cord Pneumatic Truck Tires have demonstrated their ability to reduce time and costs in comparison with solid tires in the service of the company quoted here.

A 90-mile trip has been made repeatedly on the pneumatics in 3 less hours and with $1\frac{1}{2}$ less gallons of gasoline than when covered by a solid-tired truck.

Due to the jarring and shifting action of trucks on solid tires delicate produce has been damaged frequently, whereas the pneumatics prevent such loss.

Mud has stalled the solid-tired trucks, but the tractive Goodyear Cords have proved dependable under all adverse road conditions.

An official describes the present mechanical condition of a Goodyear-Cord-equipped truck as being far better than could be expected on solid tires after a similar long term of hard work.

The photograph above affords additional and important evidence by showing Goodyear Cord Pneumatic Truck Tires still on duty after nearly a year of continuous hauling.

Additional information concerning the results obtained with pneumatic truck tires can be obtained from local Goodyear Truck Tire Service Stations or by writing to The Goodyear Tire & Rubber Company, at Akron, Ohio.



GOODYEAR

Recently Patented Inventions

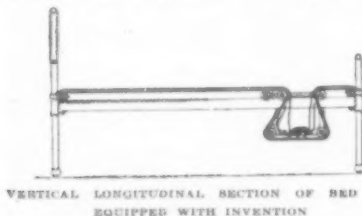
Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Of General Interest

CLOTHES HANGER.—J. KREBS, Box 109, Bedford Hills, N. Y. This invention relates particularly to clothes hangers and hat hooks which may be secured to cylindrical objects, such as the ordinary type of water heating boiler usually found in the home. An object is to provide a hanger and rack which will be clamped upon a water heating boiler, in such manner that the heat radiating from the boiler will be utilized for warming or drying clothes.

LEATHER BAG OR CASE.—G. W. Houghton, Ryecroft Walsall, England. The invention relates to leather attaché and like cases, the object being to produce a strong and durable case of neat appearance, and with economy in the use of leather. The case comprising a narrow piece forming the back and two ends, and two large pieces secured to opposite longitudinal edges of the back, one forming the lid and the staff, and the other the bottom and front, the parts are assembled by ordinary stitching or like means.

HOSPITAL BED.—J. FORD, Portneuf Station, Quebec, Canada. This invention relates to hospital beds, operating tables, stretchers and the like. A specific object is the provision of a flexible bed bottom, or table top or the like which



has an adjustable recess or well which can be moved to any point within the length of the bed or table, to facilitate operating on or bandaging the patient, or for changing the sheets, or for accommodating a bed pan.

METHOD OF MAKING SODIUM FERROCYANIDE.—T. BORGES, London, England. The invention consists in a method of obtaining crystals from a solution containing mainly sodium ferrocyanide and sodium carbonate, according to which the liquid is evaporated at say 80° C. to the point of crystallization and is then slowly cooled with the resulting separation of substantially pure ferrocyanide crystals down to a temperature of about 35° C. at which temperature the remaining liquor is drawn off before any appreciable separation of sodium carbonate crystals is effected.

CLOTHES RACK.—M. WINZELER, address Dr. L. C. Winzeler, Mason City, Ill. Among the principal objects which the present invention has in view are to conserve the space necessary for packing when the rack is inoperatively disposed, to increase the hanging capacity of racks of the character mentioned, and to provide means for readily and quickly installing the rack in service position.

AWNING FIXTURE.—A. F. NUGENT, 439 W. 26th St., New York, N. Y. The invention has for its principal objects, to overcome the necessity for employing a stay line, to prevent awnings from rising and falling, to provide a convenient lock for holding the side bars of an awning in service position, and to simplify the construction of the fixture.

MAGAZINE POWDER PUFF.—M. BIRHAN, 207 W. 115th St., New York, N. Y. The object of the invention is to provide a powder puff adapted to contain a considerable amount of face powder, and to allow for carrying it in pocket without danger of spilling the powder. Another object is to permit a limited amount of powder to pass through the puff material at each application, thus preventing the application of too much powder, and preventing waste.

MOVING PICTURE PROJECTOR.—H. H. MOMYER, Dodge City, Kans. An object of the invention is to provide a motion picture projector having a source of light including horizontally disposed alternating current are light carbons each having a crater, the two craters constituting two light spots which in effect are the apices of cones of light, the light spots being focused on the optical centers of a pair of half lenses. The effect being to eliminate flickering of the pictures.

SHUTTER FOR PHOTOGRAPHIC CAMERAS.—J. P. HANSEN, Copenhagen, Denmark. The invention concerns a noiseless shutter for photographic cameras. The principal feature of the invention is the use of bent edges on the shutter door or doors which edges cooperate with

corresponding notches in the shutter board so that in closing the door an air cushion is formed which contributes to render the closing quite noiseless, light tightness being besides obtained in a safe way, the edges of the plates overlaying one another and being provided with packing strips.

BOOK RACK.—R. B. CASS, Johns Hopkins Hospital, Baltimore, Md. The invention has for its object to provide a book rack of compact, durable and ornamental form and adjustable in length, and capable of being folded into a flat condition for storage or transportation. The rack may be adjusted in length to fit the number of books held, and the entire rack exclusive of the cross bars, may be cut from a single piece of wood.

FRUIT SORTING TABLE.—F. C. GORDON, Cashmere, Wash. The object of this invention is to provide a table of the character specified wherein a series of runways for fruit is formed by spaced rollers inclined to permit the fruit to roll down the same, the rollers being manually controlled to oscillate, to present different parts of the fruit for inspection.

MOTOR.—C. F. UECHE, New London, Wis. This invention relates to motors for draft pipes, and has for its object to provide a motor adapted to be operated by air currents wherein, a draft pipe is provided in which the motor is arranged, the pipe acting to circumscribe and direct and intensify the current that acts upon the motor. A damper is provided above the motor for regulating the air current.

TOOTH-PICK HOLDER.—S. G. SINGLETON, Box 911, Burke, Idaho. The invention relates more particularly to a tooth pick holding device, the principal object being the provision of a container which will keep the tooth picks in a perfectly sanitary condition, free from dust, insects, and the like, and also from contamination during the extraction of one or more of the picks. Another object is to hold the tooth picks in a convenient position for extraction by the fingers without necessitating the touching of any of the picks except the one selected.

WATER TANK ELECTRIC DISPLAY SIGN.—F. W. MEYER, 187½ 3d St., Jersey City, N. J. The object of the invention is to provide a sign which surrounds a water tank, tower, smoke stack or equivalent, the frame of the sign being rotatably mounted on a platform instead of being carried by the water tank or equivalent object, the means for mounting being simple and so designed that the sign can be easily operated with a minimum of electrical power.

Machines and Mechanical Devices

VALVE.—J. C. ROBERTS, New Iberia, La. The invention has for its object to produce a valve adapted for use in connection with gage cocks, globe valves, angle valves, and blow-backs, wherein leaks in the valves may be remedied without the necessity of killing the boiler, the said valve never requiring regrinding or repairing.

FRUIT GRADER.—A. GUIGNARD and F. ROSIGER, address Ideal Fruit and Nursery Co., Hood River, Ore. The invention relates to the type of fruit grading machines in which a plurality of conveyor belts travel longitudinally of the machine to convey the fruits, and transverse belts disposed above the carrier belts at various elevations serve respectively to select fruit of a predetermined size, to discharge the fruit by frictional engagement thereof into bins at opposite sides of the carrier belts.

Pertaining to Recreation

TOY.—G. KING, care Woodcraft Co., Atlanta, Ga. The object of the invention is to provide a toy wherein pairs of front and rear wheels are provided, each pair having an axle, the axle of the rear pair being secured to a plate which carries a seat while the axle of the front pair is secured to a plate having a tongue. A child may propel the vehicle by means of his or her feet, or in coasting the feet may rest upon a cross rod.

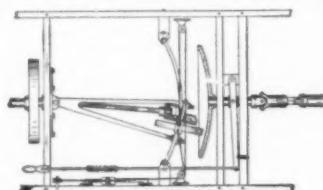
Pertaining to Vehicles

TIRE CONSTRUCTION.—J. W. PRICE, Box 651, Henryetta, Okla. The invention relates to tire constructions which are especially designed for vehicles such as automobiles. An object is to provide a structure by means of which a rubber tire may be held in extended condition regardless of punctures. A further object is to provide a spring stiffening means of such construction that the tire may be pressed entirely out of shape, but will be brought back into shape by said means without bending the latter beyond its elastic limit.

SIDE DUMPING HAND CAR.—J. G. MEREDITH, Lynchburg, Va. The invention relates particularly to hand cars of the type de-

scribed in Patent No. 1,230,005, granted to the same inventor June 12th, 1917, the object of the present invention being to provide certain means in connection with a laterally shiftable platform of cars of this character to act either as handles for assistance in the dumping, or as supports for the lowermost side of the platform in dumped position where the ground is low.

FRICTION GEARING.—G. L. JACQUES, Neillsville, Wis. The invention relates more particularly to friction driving connections for automobiles and other motor cars, the prime object being the provision of a construction wherein the driving friction member may be the softer

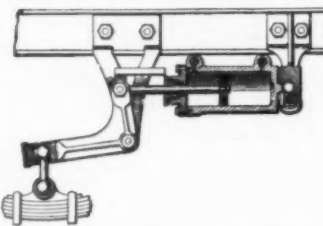


A TOP PLAN VIEW OF THE INVENTION

of the two friction members, whereby to obviate flat surfaces which cause pounding. A further object is the provision of a construction whereby the speed may be changed gradually without disengaging the friction members.

TIRE REPLACER.—C. C. F. REININGEL, Franklin Rd., Valley Stream, L. I., N. Y. The invention has for its general objects to provide a tool for quickly and easily applying the tire shoe to a wheel rim, the tool being in the nature of a lever arranged to bear against one side of the felly as a fulcrum point and having adjustable members first for engaging the inner bead of the tire; and after such bead is applied to the rim the members are adjustable to a different position for engaging the outer or second bead of the tire to pry the same on to the rim.

SHOCK ABSORBER.—G. L. JACQUES, Neillsville, Wis. Among the objects of the invention is to provide a shock absorber with connection between the running gear and the body of the vehicle. The prime object being the provision of a shock absorber which includes a piston movable within and toward the opposite end of an



A SIDE VIEW PARTLY BROKEN AWAY, AND IN SECTION

air cylinder, together with means controlled by the piston, whereby to cut off and establish atmospheric communication respectively at the front of and in the rear of the piston in its movement toward either end of the cylinder.

CONVERTIBLE AUTOMOBILE BODY.—W. H. DOUGLAS, address Healey & Co., 1662 Broadway, New York, N. Y. The invention relates to automobile bodies having a permanent top, its object is to provide a body arranged to permit of conveniently converting the same from closed to open or vice versa. Another object is to permit of conveniently taking out the rear windows, whenever desired, and to increase the inside width of the body without increasing the outside width.

AUTOMOBILE LOCK.—B. E. PICKEL, address G. S. Brown, Alpha Portland Cement Co., Easton, Pa. The object of the invention is to provide an automobile lock more especially designed for locking the steering mechanism to prevent unauthorized persons from running the automobile. Another object is to permit of installing the lock on the steering mechanism as now constructed and without requiring alteration.

SPRINGING OF VEHICLES.—A. J. ADAMS, Heywood, Near Westbury, England. This invention relates to springing of vehicles of various sorts, of the kind wherein the vehicle frame is attached to the axle fittings through the medium of bell crank lever arranged longitudinally of the vehicle and attached to the usual shackles of the laminated springs, which are replaced and acting on coiled springs placed in a horizontal position directly below the axle.

DIRECTABLE HEADLIGHT.—G. W. J. CRABB, 77 Bloomfield Ave., Newark, N. J. Among the objects of the invention is to provide means for steering a headlight for automobiles or like vehicles in accordance with the steering of the wheels of the vehicle so as to cause the light to be directed substantially in the direction in which the vehicle is to be driven. The main object of the invention is to provide a practical means whereby the headlights will be automatically steered to correspond with the steering of the vehicle.

BICYCLE HUB BRAKE.—A. L. CLEAVE, P. O. Box 984, Peterborough, Ontario, Canada. This invention relates to brakes that are more commonly used in connection with foot-propelled vehicles although certain features of the invention are applicable for use in connection with crank-operated mechanisms. Among the objects is to provide a bicycle hub brake having direct and positive forward driving connections between the sprocket wheel and the hub proper and with a very slight amount of lost motion incident to a prior actuation of the brake.

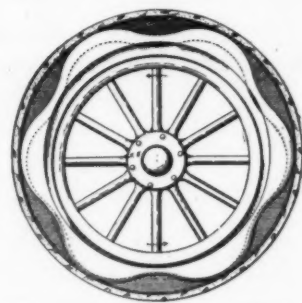
LOCK.—R. G. CAMERON, 447 Main Ave., San Antonio, Texas. The invention has for its object to provide a device of the character specified for locking the control pedals of a motor vehicle from movement in either direction, the said lock being arranged between the pedals and arranged to simultaneously engage and lock both.

HEADLIGHT HOOD.—R. H. IRELAND, 48 Nostrand Place, Richmond Hill, L. I., N. Y. The invention has for an object the provision of a construction which will cause the light to be projected an appreciable distance ahead of the lamp and on each side thereof, sufficiently to comply with the law of any State. Another object is the provision of a hood which may be readily attached to substantially any kind of lamp now on the market without change either in the hood or the lamp.

ADVERTISING DEVICE.—T. DOUGHERTY, 526-59th St., Brooklyn, N. Y. The invention relates to changeable exhibitors or advertising appliances, and has particular reference to means for causing the presentation of variable panels in succession at certain fixed predetermined viewpoints. Another object is to equip a moving object such as a vehicle with changeable advertising appliances with facilities for actuating the appliances from moving parts of the vehicle during progress.

RESILIENT WHEEL.—I. ROSENFELD, Room 26, Nat'l Bank of Montana, Helena, Mont. Among the objects of the invention is to provide a resilient wheel in which rubber or other similar cushion members are utilized and the resiliency or spring of bowed metallic spokes is utilized for producing the desired effect, a very resilient structure under ordinary circumstances and a much stiffer resilient structure for special circumstances.

AUTOMOBILE WHEEL.—A. W. ALTHOFF, 308 East First St., Tulsa, Okla. This invention relates to wheels of the floating-hub type, an object being to provide a wheel which will absorb shock. The outer rim of the wheel is provided on its inner surface with a channel in which the edge of the inner or floating portion movably fits, the channel being fitted with thick, specially prepared lubrico to absorb shock. An extra compartment



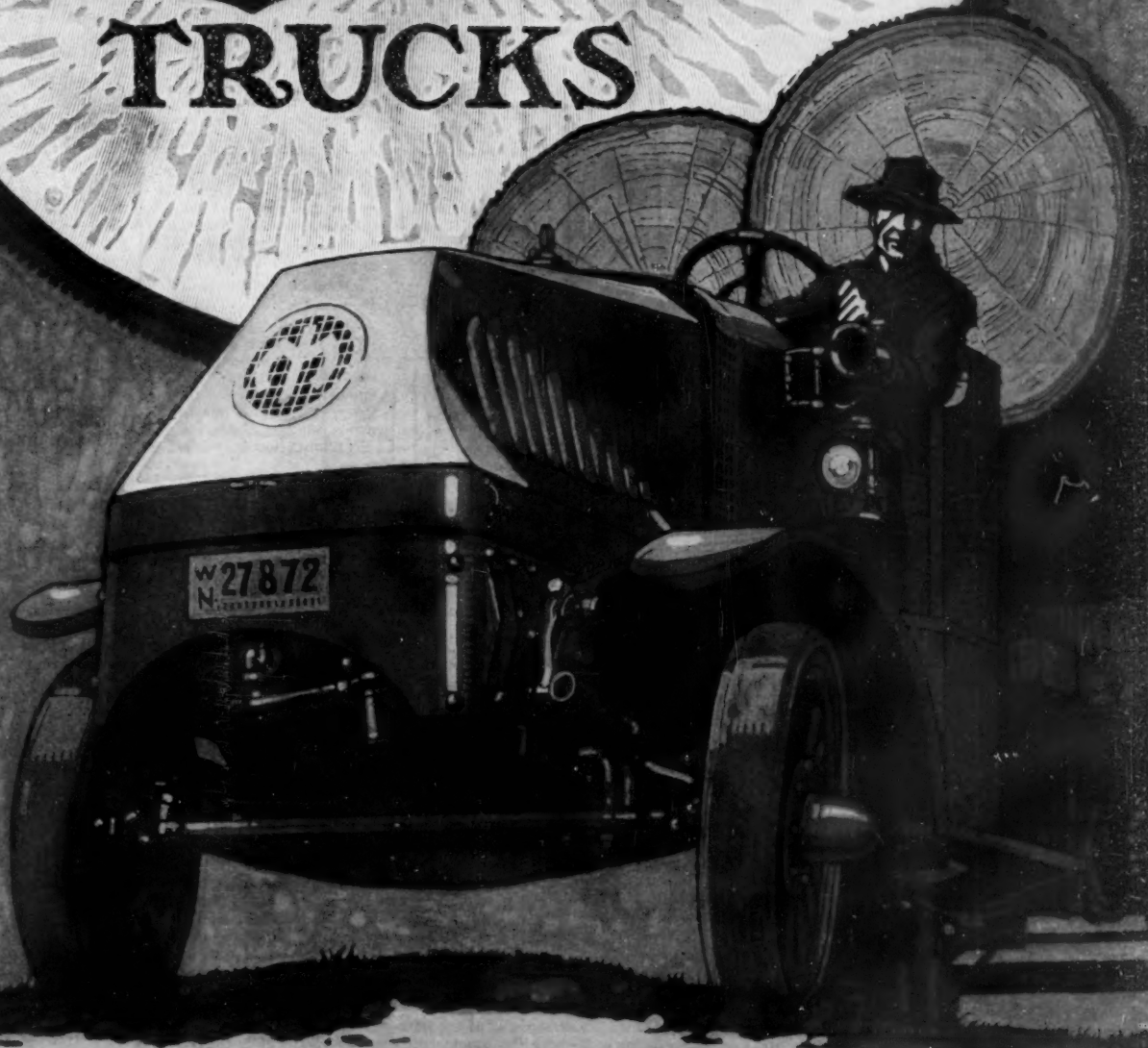
A PERSPECTIVE VIEW OF THE WHEEL AT REST

in the rim carries the over-compression of the movable substance supply and eccentric movements of the inner floating portion places the supply again in communication within the channel. Another feature is a tread composed of traction plates or blades with a concrete material interposed between them.

(Continued on page 20)

Mack

TRUCKS



ERNEST
HAMLIN
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"PERFORMANCE COUNTS"

Power and strength! These two qualities of MACK Trucks impress themselves on all observers. They are the outward indications of that inward perfection of design and manufacture

that keep MACK Trucks constantly on the job. Bodies for all kinds of service and special loading and unloading appliances, too.

Capacities 1 to 7½ tons. Write for catalogue.

INTERNATIONAL MOTOR COMPANY, NEW YORK

RECENTLY PATENTED INVENTIONS

(Continued from page 18)

Pertaining to Aeronautics

AEROPLANE SIGNAL.—E. G. BALCH, 103 State St., Newburyport, Mass. The invention relates to variable light or color signals to be transmitted through great distances and recognized by sight as distinguished from hearing or other senses. Among the objects is to provide a signaling system for use on rapidly moving vehicles, the system including one or more light units each of which is provided with a plurality of hull's eyes so arranged that at least one of them will be visible irrespective of the direction from the observer in which the vehicle may be located.

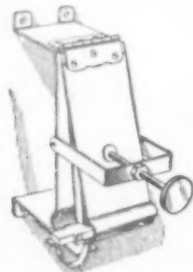
Electrical Devices

CONTACT PLUG.—W. J. KOENIG, 53d St. and 18th Ave., Brooklyn, N. Y. This invention relates to electric plugs or connectors and has particular reference to connectors that are intended for easy manipulation and frequent connection and disconnection. Among the objects is to provide a plug that has maximum strength and reliability for all practical purposes, and yet which can be made at a minimum cost.

Of General Interest

REST FOR BOOKS AND OTHER READING MATERIAL.—W. A. DeLONG, JR., 233 Broadway, New York, N. Y. Among the objects of the invention are to provide a stand affording a rest for books, magazines or other reading matter, it more particularly relates to a device to be employed by a person seated in a chair. The book rest proper is carried by a stand made in telescopic sections, it is provided with means to retain the book or other matter and has adjustable features to dispose the book at the proper distance from the person seated in the chair anchoring the structure.

DEVICE FOR EXTRUDING PASTE FROM TUBES.—E. G. ROACH, 1785 Walton Ave., Bronx, N. Y. The invention relates to means for extruding the contents of collapsible tubes, such as those containing dental paste, skin creams, artists' colors, adhesive paste, etc., it particu-



PERSPECTIVE VIEW, SHOWING THE DEVICE IN SUPPORTED POSITION

larly relates to a device to be secured to a wall or other fixture and adapted to receive the tube, means being provided to subject the tube to pressure for extruding the contents. The pressure means is of a character to make it unlikely that an excessive amount of the contents will be expelled at a given operation even by a child.

DISPLAY STAND.—J. A. BRADY, address F. J. REARDON, 71 Montgomery St., Jersey City, N. J. The particular object of the invention is to provide a stand applicable for the window display of goods. One of the main features is the provision of a device which may be folded together so as to occupy a minimum of space when shipped or not in use, and to provide a display stand in which none of the parts connecting the various elements may be visible from in front of the same.

SELF PROPELLED SLED DEVICE.—J. SCHREIBER, 283 Grove St., Jersey City, N. J. The invention relates more particularly to a device which will permit a sled to be self-propelled when used on substantially level ground. One of the objects is to provide a sled of simple, strong and durable construction with its parts so arranged that the sled may be readily propelled by the occupant by a sliding member which may be operated by the hands to move the sled forward when used on a relatively level snow or ice covered surface.

STEREOSCOPIC CAMERA.—J. A. DECUIN, 168 Point St., Providence, R. I. An object of the invention is to provide a camera by means of which a stereoscopic image may be projected on the film or ground glass, each image having the appearance of solidity as if viewed through a stereoscope. The construction comprises a lens tube having therein three slidable lens carriers, one of said carriers having a pair of lenses arranged to focus at points distant from one another, another carrier having a pair of prisms movable toward and away from either of the other carriers, and a third carrier having a single large lens.

PINWHEEL NOVELTY.—G. MARTEL, 828 Union St., Brooklyn, N. Y. The object of the invention is to provide a pin wheel novelty arranged to attractively display the national flag or other patriotic emblems. Another object is to permit of readily attaching the novelty to a coat or other article of wear, or to a stick or supporting device, to expose the pin wheel to the action of the wind with a view to its being rotated in the usual manner.

WATCHCASE.—L. LOEB, 71 Nassau St., New York, N. Y. This invention relates particularly to a case for a wrist watch, the particular object is to provide a construction whereby a simple strong structure is produced with a minimum number of parts. Another object is the provision of a case in which a bezel is formed in such a manner that the crystal or glass may be placed in position from the outside of the case.

CATTLE GUARD.—T. M. FISHER, Bastrop, Texas. The invention has for its object to provide a device formed from sheet metal sections adapted to be arranged between the rails and on the outer sides of the rails to prevent the passage of stock. The metal sections are formed with a series of upwardly extending pointed tongues which will deter any stock tempted to cross the guard.

OXIDATION OF METHANE.—R. K. BAILEY, 2018 F. St., N. W., Washington, D. C. Among the objects of the invention is to provide a process by means of which the oxidation of methane to form such products as formaldehyde may be carried out in a minimum of time. The process consists in mixing with the methane a substance having nitrogen and oxygen combined, at least in substantial parts chemically, so as to constitute an oxidizing gas, heating the mixture, cooling the heated mixture, and simultaneously naturalizing certain of the products by means of calcium carbonate or its equivalent.

COLLAPSIBLE TOWER.—W. L. BESSOLO, San Diego, Cal. The invention relates particularly to a collapsible tower of a nature capable of varied use, and especially of use as a wireless tower, observation tower, elevatable gun support, or in connection with fire apparatus. The object being the provision of a simple and strong mechanism capable of ready adjustable control as well as quick elevation and collapsing movement, with minimum friction and expenditure of power.

Hardware and Tools

QUICK-ADJUSTABLE WRENCH.—W. L. BESSOLO, San Diego, Cal. The invention relates particularly to a quick adjustable wrench capable of a variety of uses, it consists of a pair of curved jaws having inner toothed faces and having a crossed and pivoted relation to one another, one of the jaws being rigid with a shank forming a part of the handle of the wrench, and the other being adjustably engaged by a transversely extending spring controlled jaw actuating member.

BOX STRAP.—P. F. FORBES, 50 Columbia Heights, Brooklyn, N. Y. Among the objects of the invention is to provide a metal strap provided with nail holes to permit of quickly driving the nails through the holes into the material of the box to fasten the strap in place, to provide means for guiding the nail to the hole, thus facilitating the operation of nailing, and to provide the strap with fractured bosses adapted to embed themselves in the wood or other material of which the box is made, thus aiding the nails in holding the strap in place.

CLAMP APPLIER.—J. ZELLER, Moberge, S. D. The invention relates to a clamp applier for clamping flexible tubes by means of wires. The particular object of this device is to provide a tool of simple construction, resulting in the consequent economy in manufacture, yet will in a perfect manner draw the wire clamp firmly around the hose.

CLEVIS.—E. W. ST. ONGE, 1517 Tower Ave., Superior, Wis. The invention has for its object to provide mechanism for use in connection with the clevises, for preventing displacement of the bolt, and for preventing the spreading of the arms of the clevis at the bolt. The device insures a firm engagement, at the same time providing for an easy disengagement, any tendency of the clevis to spread with this holder, tightens the holder on the bolt.

TOOL HANDLE.—C. SMITH, Albuquerque, New Mexico. The invention has for its object to provide a simple handle which may be made of hard wood, and which has a size adjustment for tools. The handle comprises a grip portion and a shank which is provided with radial longitudinally extending cuts, forming tongues of slightly less thickness than the width of the file to be held. There is an annular shoulder between



A SIDE VIEW OF THE DEVICE AS APPLIED TO A FILE

the handle and the shank, and a ring is mounted to move toward the shoulder thus forming a clamp for the tool.

QUICK ADJUSTABLE WRENCH.—W. L. BESSOLO, San Diego, Cal. The invention relates more particularly to a quick adjustable wrench, the object being to provide a simple construction including fixed and movable jaws, the former of which may be quickly adjusted toward and away from the movable jaw in applying the same to work, by means which also act in part to secure pressure movement of the movable jaw toward the rigid jaw during the operative use of the wrench.

QUICK ADJUSTABLE WRENCH.—W. L. BESSOLO, San Diego, Cal. This invention relates more particularly to a quick adjustable wrench in which provision is made for various adjustments, the object being the provision of a strong powerful and durable wrench which will at the same time be comparatively simple and inexpensive.

PROTRACTOR AND GAGE.—E. T. AYERS, 454 Md. Ave., Washington, D. C. The invention relates generally to protractors, and more particularly to a combined protractor and gage, the object being the provision of a simple implement of this nature susceptible to ready adjustment and manipulation, and capable of various uses and of efficient and effective results.

Heating and Lighting

BOILER.—M. E. HERBERT, care Herbert Boiler Co., Root and La Salle Sts., Chicago, Ill. The invention has for its object to provide a boiler so arranged as to receive a maximum amount of heat from the fuel consumed, the boiler having a water chamber and water tube section, each section consisting of a pair of casings spaced apart, each casing being partitioned horizontally into upper and lower compartments, the upper compartment of each casing communicating at one end with the water chamber, and the lower compartment communicating at the other end of the water chamber.

Machines and Mechanical Devices

PISTON.—C. L. STANCLIFF, 2332 Chester Ave., Bakersfield, Cal. The object of this invention is to provide a detachable connection between the piston and the piston rod, by means of which a new piston can be fitted to the cylinder without disassembling the motor, or loose bearings, and like troubles may be remedied from the top of the piston, and wherein the piston grooves and rings may be cleaned without removing the piston from the cylinder.

COTTON GIN CONDENSER.—M. J. CROCKER, 1622 York Ave., Memphis, Tenn. An object of the invention is to provide means for condensing cotton after leaving the gin. Another object is to provide means for separating dirt dust and foreign matters from cotton after leaving the gin, and to prevent the passage of dust and dirt along with the condensed cotton.

Musical Devices

DRUM COVER AND RAIN PROTECTOR.—A. GOLDBERG, 375 E. 136th St., Bronx, N. Y. The invention relates to musical instruments and has particular reference to reliable protectors of the drum head from rain, snow or the like, making it possible for the drummer to meet any engagement without regard to weather and enabling him to manipulate his instrument with little or no inconvenience to him, and with but a slight muffling of the music.

Prime Movers and Their Accessories

MAGNETIC ATTACHMENT FOR ENGINES AND THE LIKE.—H. L. KEUN, 6847 Wentworth Ave., Chicago, Ill. This invention has for an object the provision of an attachment for engines, for cleaning oil of foreign matter and thereby causing a better action of the moving parts. Another object is to provide a construction which may be attached to the timer or to other parts of machinery in an internal combustion engine for removing the waste or loose magnetic material or other foreign matter from the oil.

COMPOUND GAS ENGINE.—H. W. KINNEY, Lynchburg, Va. This invention relates to internal combustion engines and has to deal more particularly with a compound engine for automobiles or other uses, whereby additional power can be obtained, greater flexibility secured, as well as facility in starting. A more specific object is the provision of a combination of a main explosive engine, with means such as a pressure reserve tank to which products of combustion are admitted through a special valve before the piston of the engine reaches the end of its working stroke.

Railways and Their Accessories

RAIL TIE AND CLAMP.—J. E. LANGFORD, 818 E. 21st St., So., Salt Lake City, Utah. The invention relates generally to rail ties and clamps and is more particularly a composition tie having means embedded therein adapted to provide for the effective holding of rails against displacement or overturning; the outer surface being such that

it may be immovably supported in the road bed and will be durable and very effective in use.

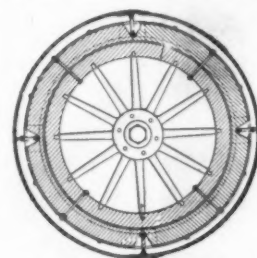
Pertaining to Recreation

CIRCULAR SWING.—M. JOHNSON, 249 56th St., Brooklyn, N. Y. The invention relates to amusement apparatus such as are used in pleasure resorts, its object is to provide a circular swing of the centrifugal type arranged to provide an exhilarating ride for its patrons. Another object is to enable the operator in charge to vary the action at will thus producing varying sensations in the occupants of the passenger carriers during the ride.

GAME APPARATUS.—R. G. CLARKE, 662 W. 184th St., New York, N. Y. Among the principal objects which the invention has in view is to provide a parlor baseball game in which the players may use their judgment, and not necessarily leave the outcome of the game entirely to chance, to provide means whereby the plays will occur relatively to each other as the average in the regular field game, and to furnish two sets of three cubes or dice, that can be composed into eight sets, each set representing a pitcher of different ability.

Pertaining to Vehicles

VEHICLE TIRE.—F. J. PEIRCE, Parkers Landing, Pa. The invention relates to tires for vehicles including automobiles and trucks, and more particularly to a tire to be employed in lieu of pneumatic tires, including elements whereby it is convertible for use either as a summer or



A VERTICAL SECTION, INCLUDING A SUMMER TIRE CERTAIN ELEMENTS OF THE WINTER TIRE REMOVED

winter tire. A further object is to coordinate the winter and summer tires so that the latter at the exterior will be resilient and may readily be applied to the wheel without removal of the winter tire as a whole.

RESILIENT VEHICLE WHEEL.—H. H. SCHRAMM, 28 West 48th St., New York, N. Y. The invention relates to vehicle wheels provided with a cushion between the felly and the tread, the object being to provide a resilient wheel more especially designed for use on automobiles, auto trucks and similar vehicles, to give resiliency without danger of puncturing or otherwise injuring the cushion. Another object is to permit of using the wheel in case the cushion is rendered inactive for any reason.

Designs

DESIGN FOR A HEADLIGHT DIMMER.—P. P. HEIN, care Joseph Bory, 444 E. 79th St., New York, N. Y.

DESIGN FOR A CONFECTION CONTAINER.—W. F. HITZEMAN, care Hlios Chemical Co., 366 Atlantic Ave., Brooklyn, N. Y.

DESIGN FOR A COVER FOR A POWDER CONTAINER OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, Bush Terminal, No. 10, care Manhattan Can Co., Brooklyn, N. Y.

DESIGN FOR A RECEPTACLE.—C. S. HUMPHREY, Bush Terminal No. 10, care Manhattan Can Co., Brooklyn, N. Y.

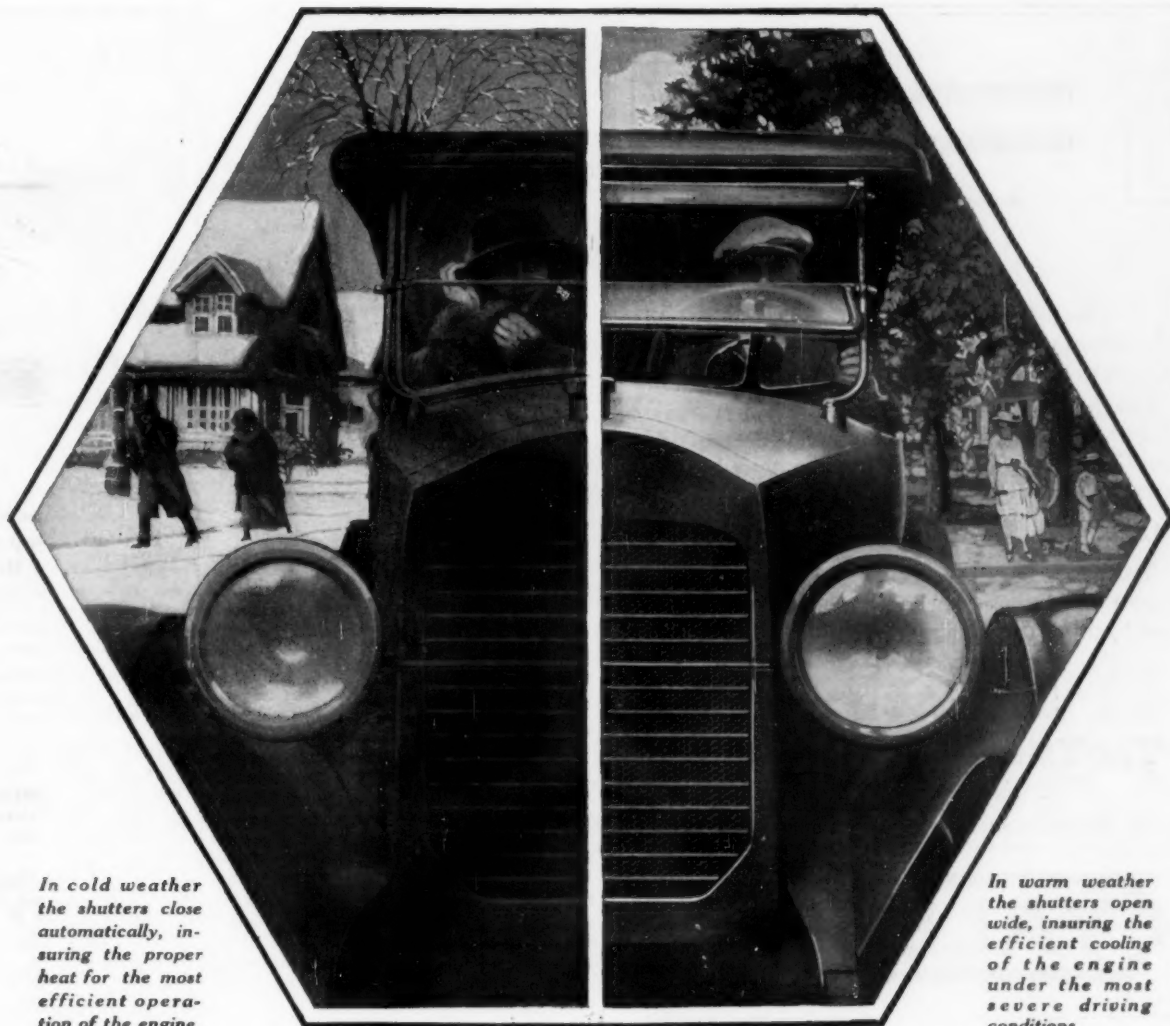
DESIGN FOR A CAN OPENER.—O. KATZENBERGER, care Lawson Mfg. Co., 228 W. Superior Ave., Chicago, Ill.

DESIGN FOR A BUTTON.—W. J. KLEIN, address Halheimer Bros., 49-51 W. 24th New York, N. Y.

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The ordinary radiator is a compromise between winter and summer driving conditions.

To cool the engine satisfactorily on the hot days of mid-summer and in warm climates, it must be of a size and capacity *far in excess* of winter requirements. Over-cooling in the winter time results—which means gasoline condensed on the cold cylinder walls, diluted lubricating oil—a balking “spitting” engine—excessive wastes in gas and oil consumption.

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When engine temperature exceeds 180 degrees (the point of greatest combustion efficiency), the shutters are wide open—increasing cooling power to the maximum. When the temperature drops to 140 degrees, the shutters are closed completely—conserving the heat.

Quick “warming-up”—easier starting—improved carburetion and ignition—gasoline and oil economies result.

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Because it is *not* a compromise, the Harrison Shutter Radiator makes any automobile on which it is used an all-season, any-climate car.

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The Refinement of Details

(Continued from page 7)

presented, the lines being greatly improved throughout in many cases due to a new method of body mounting in which the body is suspended on brackets attached below the upper edge of the chassis frame, instead of being mounted on top of the frame as formerly. The result has been to drop the body sides several inches closer to the ground, giving an unusually low hung appearance, without sacrifice of road clearance. Also the construction has been stiffened, due to the sills being laid on edge, instead of flat, and body squeaks and rattles have consequently been permanently eliminated.

Minor improvements in the body include such refinements as sheet metal aprons concealing the gasoline tank, a well in the front floor boards for the tire pump connection that is concealed by a pressed steel cover, the carrying of the emergency starting crank in a pocket tailored into the lining of the cowl, and the method of holding down the floor boards by resting them on brackets with integral studs projecting through the boards, to the upper ends of which are fastened nickel plated half nuts.

The Romance of Invention—VI

(Continued from page 8)

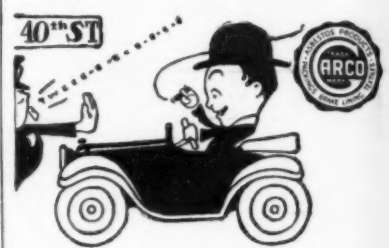
than most. He will tell you . . . has told you in a little book which he wrote, called "Dynamite Stories" . . . that he paid the price of a left hand to learn something about the respect due to fulminate of mercury. What his book doesn't tell is that after the explosion, it took all day to get a doctor. When the doctor commenced to work, someone said something about examining Mr. Maxim's heart to see whether or not he could stand an anaesthetic. "Don't bother," answered the doctor. "Any man who can stand the day this man has been through and still smile hasn't got any heart or nerves either." If any one chooses to wonder whether Mr. Maxim's moral courage is backed up by physical courage, there is the answer.

Smokeless powder as used by the United States Government, consists of grains which are short, multi-perforated cylinders, the invention of Mr. Maxim. These multi-perforations through the grains are of the utmost importance. Like many great inventions, the wonder is as much in the simplicity as in the effect.

The important thing in any explosive propellant is to get the maximum driving effect of the projectile. This result is secured by the Maxim powder by reason of the fact that the combustion of the grains is not instantaneous, but, comparatively speaking, gradual. The entire surface of the grain, within the perforations and on the outer surface, is simultaneously ignited. As the combustion in the perforations enlarges them, more and more surface is presented to the flame. This liberates the gases more and more rapidly, which serve to keep the pressure up behind the projectile in its flight along the bore of the gun.

Mr. Maxim's smokeless powder and other explosives were purchased by the DuPonts, with which concern he has ever since been connected as consulting engineer. Maximite, his high explosive, and certain improvements in delay action fuses, were exhaustively experimented with by the Government, which has adopted them. Motorite, a strange new combustible material, is another of Mr. Maxim's inventions in the realm of explosives. It is designed as a propellant for torpedoes and Mr. Maxim has also developed the device for its use, in which bars of it, forced into steel tubes to confine combustion to one end, provide intense heat to make steam, the steam and products of combustion together being used to drive the mechanism of the tor-

(Continued on page 24)



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All storage batteries are high-strung and ambitious. Unless restrained by the new method they are no sooner born than they begin to chafe inwardly—to wear away their vital elements in an eagerness to do something. And this wearing away, slow but sure, proceeds, through the months "on the shelf" at your dealer's or at battery stations.

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Not so with USL Dry-Charged Batteries. The USL unique and exclusive Dry-Charged, distribution-method frees batteries from all before-sale deterioration.

The USL Battery does not leave the factory half finished to avoid "wet-shipping". Everything needed to make the battery ready to work is accomplished *at the factory*, because only there can it be done with *sure* results.

Then, the USL Battery is at once drained of electrolyte, thoroughly washed, and effectually air-sealed to protect it from self-attrition and shipped to your Service Station. While in this condition it is resting, doing no work—using up none of its full measure of battery-life.

When you need a new battery, your USL Service Station restores the electrolyte, gives the battery a few hours' freshening charge and hands you a *new* new battery with a full measure of vital energy and life.

Twenty-five hundred USL Service Stations and dealers make this direct-to-owner-delivery of *new* new batteries possible, both for regular equipment on new cars and for replacements on old cars.

Thus batteries are saved from before-service wear and owners freed from the money tax for prior-to-purchase loss of battery-life. That's the *exclusive* USL DRY-CHARGED principle.

- (1) USL Batteries are *USL Dry-Charged*.
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For a Luxury Shave

Use Shavaid Just Once
Then Compare the New Way with the Old

This new scientific way of softening the beard insures an easier, quicker, more comfortable shave. Perfected after many tests and experiments, Shavaid does instantly what men have been trying for years to accomplish. A Free Trial Tube will convince you. Send for it today.

MEN the nation over are trying this new way. Every one who tries it adopts it. It is what every man has been looking for.

Shavaid softens the beard instantly, so that the razor "takes hold." It makes shaving a positive pleasure. The beard is removed easily, smoothly, without "pull" or smarting sensation.

The Better Way

Noneed now for hot towels, for rubbing in the lather. These old methods take time. They draw the blood to the surface, open the pores, make the skin tender. Shavaid does instantly what these harsh methods were meant to accomplish.

Shavaid soothes and heals. Its beneficial influence is felt instantly. The burning, smarting, after-shaving sensation is gone. In its place is felt a cool, comfortable satisfaction. That is why Shavaid makes a luxury shave.

Real Shaving Comfort

You will note the cooling, soothing effect as soon as you apply Shavaid to the dry beard. Then apply your favorite lather. Shavaid works better if the lather is *not* rubbed in. Shavaid softens the beard perfectly, prepares

it properly. It keeps the lather moist and creamy.

As the blade glides over your face, you will be surprised at the absence of "pull," of all smarting. No injury is done to the tender skin—there is no need for after-shaving lotions or creams. Your face will feel cool and comfortable.

Do you shave close? Shavaid will prove a positive revelation to you. Not only will you experience a new satisfaction in shaving—a new after-shaving comfort. Your face will be in better condition than it could ever be under the old methods. It will be smoother, firmer, younger looking. It will lose that unnatural dryness, that "drawn" feeling.

Try it—Free of Charge

The way to find out what Shavaid will do toward giving you an easier, quicker, more satisfactory shave is to send for a Free Trial Tube. That will show you. Thousands of men are using Shavaid today. But you must test it for yourself. Just fill out the coupon and mail it now—before you forget it. Then when your trial tube comes, see for yourself what Shavaid is.

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City..... State.....

Free Trial Tube

The Romance of Invention—VI

(Continued on page 22)

pedo, resulting in four times as much energy as can be obtained from the use of compressed air, for the same torpedo.

Mr. Maxim has also produced stabilite, a smokeless powder which can be used the day it is made, and his various contributions in the art of fuses and explosives manufacture are too numerous here to catalog.

It is interesting to note that as early as 1897, while in England, Mr. Maxim delivered a lecture before the Royal Service Institution in which he demonstrated that the destruction of such forts as those at Liege and Namur was possible, and described the type of howitzers which could accomplish it. When these forts were reduced, the Germans used ordnance the principles of whose design were based upon that which Mr. Maxim had predicted could be used. It should also here be chronicled that Maximite was the first of the high explosives ever made insensitive enough to stand the shock of being used in an armor-piercing projectile, and that the modern practice of delay-action fuses, which puts the shell through the protecting armor and explodes it inside a ship or fort, is a result of Hudson Maxim's work.

Mr. Maxim has turned his busy brain to a great many different things. Among them is a game which he calls "War" and which he describes as "an improvement on chess." However much the devotees of Caissa may deny that chess is capable of improvement, no one has tried "War" but is willing to admit that the inventor has produced a very interesting game, and one in which the complications of chess have been raised to the nth power. It is also interesting to hear that F. J. Marshall, American Chess Champion, suffered defeat in only the first three games of "War" he played with the inventor. "After those first games," and Mr. Maxim chuckles at the memory, "I couldn't do anything with him, playing my own game."

Mr. Maxim is at present much interested in food, and especially in producing a new army ration. He is the inventor of so-soya, a word coined from "some" and "soya," indicating that the product contains some soya beans. Mr. Maxim believes that the soya bean, a staple in the East, must eventually become a staple in the West, on account of its great food value. He has worked over it until he has eliminated the harsh and uninviting taste which has prevented soya from being popular to Western palates and believes that both "so-soya" as a food element and his other preparations of soya beans must eventually find a prominent place on both American and European tables. Incidentally, it must not be forgotten that Mr. Maxim is himself an expert cook, and possesses a skill in preserving, jelly-making and canning which any housewife might well envy.

Personally, Mr. Maxim is beloved of a large circle of friends. He has a boundless enthusiasm for whatever interests him, and the quality of inspiring enthusiasm in those who work with him. Whether he is amusing himself on the tennis court, with the gloves, or driving his car at quite reckless speed about the roads near his estate on Lake Hopatcong, N. J., admiring paintings, of which art he is a patron, experimenting with a new jelly, testing a new explosive, writing a poem, playing "War" or poker, dictating a letter or a lecture or engaged in argument, Mr. Maxim does what he does with all his might.

It is this "maximight" of bodily and mental power which make the man the driving force he is for good, as well as the underlying cause which has pushed him to the front as one of America's leading men of science and one of our greatest and cleverest constructive thinkers.

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Making the Automobile Complete

(Continued from page 9)

cylinder block. When the motor attains its efficient operating temperature promptly, the pistons and rings expand to their proper fit and the escape of raw gasoline past the pistons into the crank case where it will dilute the oil is minimized.

Unless a storage battery is kept properly charged during the winter season, especially if a car is operated very little owing to the severity of our northern climate, there is apt to be a marked decrease in battery capacity due to sulphation of the plates and besides, the electrolyte of a depleted battery is apt to freeze if the car is kept in an unheated garage. The rectifier shown at 8 is the product of a large producer of electrical appliances and permits the motorist who has only alternating current available to give his storage battery a "boosting" or conditioning charge whenever necessary and thus keep the battery in condition even if the car is not used for extended periods.

A combined speedometer and recorder is shown at 9. This device not only gives the total and trip mileage but also shows the mileage of any tire from one to six, thus enabling the careful motorist not only to check the service given by the tires regularly used on the car wheels, but also to keep track of the service given by the spare tires if these are used in emergencies.

The extension-handle jack shown at 10 is a very strong jack intended for garage or service station use and is a quick-acting, strong jack for heavy duty. The operating lever or handle is five feet long and makes it easy to lift heavy cars. The length of the handle makes it possible to place the jack under the axles or other hard-to-reach places.

Quick detachable non-skid chains which are made in various sizes suited for both trucks and passenger cars are shown at 11. This is a simple chain device consisting of a pair of cross-chains attached to a fastening device that attaches to the wheel spoke as indicated, permitting quick attachment and removal.


A combination tire holder for light cars is shown at 12 that is said by its makers to provide for the dual functions of a spare tire carrier and rear bumper. It is made of steel throughout and the steel cradle is reinforced with a rib.

The increasing boldness of motor car thieves and the small penalty they suffer when apprehended make it important for motorists to take all the precautions they can to prevent stealing of motor cars. The lock shown at 13 is attached to the steering gear under the steering wheel and clamps the steering apparatus so the front wheels cannot be turned.

The heavy-fuel system shown at 14 is being produced commercially by a well-known accessory manufacturer and is claimed to be a method of carbureting heavy oils that has been found to be extremely satisfactory on heavy duty apparatus such as tractors, motor trucks, etc. A heating chamber is combined with the intake manifold of the engine and is heated by the exhaust gases. It is placed directly over the spray nozzle of the carburetor and the heated chamber completely vaporizes any liquid that may be sprayed into it.

When driving in rainy or snowy weather, the windshield becomes cooled with moisture or ice and is hard to see through. The cleaner shown at 15 is made in two forms, one to be attached to the windshield frame, another that is installed by boring a hole in the windshield glass as illustrated. The cleaners are made of chemically treated felt.

The storage battery cell tester shown at 16 is a device that consists of a recording meter and a special nichrome wire resistance which connects the prods. The sharp pointed steel prods establish a suitable connection with the lead cell



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connections or binding posts and make it possible to take cell voltage readings.

A combined tire inflating valve, recording gage and automatic relief valve, as well as a simple hose coupling is shown at 17. This fitting is attached to the air hose of a hand or power air pump and is screwed on the air valve as any pump connector is. The knurled knob at the top is turned until the notch indicating the desired pressure is in contact with the indicator pin.

A device to be attached to the radiator cap of an automobile that serves the purpose of an alarm when the motor overheats and also a condenser for steam is shown at 18. When steam escapes it makes a whistling sound; when alcohol is used in the cooling solution as in the winter months, the vapors are condensed and are returned to the radiator.

The Nature of Things

(Continued from page 10)

"instant" we are not conscious of the whole of the world-space of four dimensions, but only of the three dimensional "cross-volume of consciousness."

As an illustrative analogy, we may consider the observations that would be made by a two-dimensional man who lives on the surface of the water in a reservoir, and who is conscious only of phenomena which occur on that surface. Suppose that the water-level is rising at a fixed rate. Let a smooth telephone pole be placed vertically in the reservoir, part in, part out of the water. The flat-man can observe only the circular cross-section of the pole made by the surface of the water and this will remain apparently fixed in position and circular in shape as the water level rises—that is, as "time" goes on. The flat-man can have no knowledge of the rise in water-level of the cross-sections of objects, where they cut the surfaces. If, however, the pole is slightly inclined from the vertical, the flat-man will say, "The pole is moving," because the place of intersection of pole and water-surface will be changing position on the surface as the level rises; and this cross-section is the only "pole" the two-dimensional man can know.

Furthermore, if he makes careful observations, he will notice that his cross-section of the "moving," or inclined, pole is not circular, but elliptical; and he will be forced to the conclusion that bodies change their shape when they move. In addition, he would decide that the "moving," or inclined, pole did not keep the same "time" as the fixed (vertical) one; provided that we stipulate that another flat-man who lives in the pole measure his time always by the rate at which water climbed up the pole when vertical.

Time as a Fourth Dimension

There is no value in pushing this analogy farther here; it sounds foolish enough already, perhaps. In science, however, nothing is foolish that works. We may assume that our relation to time is somewhat similar to the flat-man's relation to the rise in the water-level, and then work out the consequences; and if the observations of nature agree with these, then the assumed hypothesis is true to the extent that any theory is true in physics. It works. If, now, we assume that our velocity along the fourth, or time dimension is that of light, which is, roughly, the Einstein-Minkowski hypothesis, we do find that the effects worked out from this assumption actually are verified by observation. A moving sphere appears ellipsoidal to a fixed observer, just as the moving circle appeared elliptical to the flat-man on the water.

In Minkowski's mathematical treatment the time dimension is taken as "imaginary" in the algebraic sense. The student who attempts to push our water-level, telephone-pole analogy too far will, on this account, arrive at results a little

different from Einstein's; but in spite of this the analogy gives an approximately correct idea of the real meaning of the relativity transformation.

If the Einstein time-space be assumed as a physical reality, quite startling and picturesque experiments can be devised. Fortunately or unfortunately, practical means of carrying through such experiments are lacking at present. Thus, if a man could be put in motion with a velocity comparable with that of light (and if he survived the process), his time relations might be considerably twisted, and what seems to us the future might be his present, or vice versa; while he could easily be in several places at what would appear to us as the same time. Thus that fantastic romance by H. G. Wells, "The Time Machine," wherein a man devises a usable means of traveling at will through time, is brought out of the realm of pure imagination into that of (highly) speculative science.

To dwell too much on such fantastic implications of the theory of relativity is inadvisable, because it distracts attention from the solid scientific value of Einstein's work. Neither is it necessary, in spite of the fact that these concepts rest on the assumed existence of absolute distance, time, and mass, to claim for the theory of relativity that it overthrows Euclidean geometry, or that it supplants Newton's law of gravitation or that it proves untrue our "common sense" ideas of time. Euclidean geometry and Newtonian dynamics alike serve the purposes for which they were constructed; but they are not applicable with complete generality. The theory of relativity, on the other hand, is believed to hold good in all cases. In problems that do not involve high velocities, relativity reduces to Euclidean geometry, and Newtonian dynamics, and common sense time, as a special case; but when the velocities met with in a problem are large, then relativity predicts effect which, it seems, exist in nature, though "contrary" to Newtonian dynamics.

All physicists do not believe in the Einstein theory; possibly a majority of them do not, at present. It is too new. If it ever comes to general acceptance, the reason will be that, in common with all successful theories in physics, it has the ability to predict new phenomena, and to correlate all important known phenomena in the field to which it applies. And the Einstein theory applies to a large part, nearly the whole, of physical science. It deals exhaustively with space, time, and matter, and with light and electricity in part. It binds together the work of Newton and the work of Maxwell.

Newton, according to tradition, saw an apple fall from a tree, and was led to calculate the rising and setting of sun, moon, and stars. Einstein, if the newspaper report is correct, saw a man fall from a high building, and afterwards questioned him concerning his sensations while falling—thus going Newton one better. Einstein can explain everything that Newton could, and, in addition, the slight wobble in the orbit of Mercury which the followers of Newton could not account for, and the deviation in the path of light which we had never noted until Einstein told us to look for it. On the other hand whether or not the theory of space, time, and gravitation that has been devised by Einstein shall finally be accepted, we cannot but be astonished at the boldness which bridged the gap between the man who fell from the roof and the light which the South American eclipse photographs detected falling toward the sun last May.

The All-Year Car

(Continued from page 12)

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